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. II.—Vol. 14.
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The Practical Teacher

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The Practical Teacher

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Wisdom is humble that he knows no more.'—COWPER.

VOL. XIV. NO. 11. MAY, 1894. PRICE, 6D. POST FREE, 8D.

ON THE TRAINING OF TEACHERS.

[*A Paper read by Mr. A. Sidgwick, M.A. (Fellow and Tutor of Corpus Christi College and University Reader in Greek to the University of Oxford), before the Easter Conference of the N. U. T. at Oxford, on Tuesday, 27th March*, 1894.]

MR. PRESIDENT, LADIES AND GENTLEMEN,—I wish to state clearly from the outset that I decline to consider it an open question, whether all school teachers ought to be professionally trained and certified. In every other art, or craft, professional training and apprenticeship is a practical or legal necessity. But in the profession, which is undeniably one of the greatest difficulty and of the first national importance, the public, over a large part of the field, has no sort of guarantee of the efficiency of the instruments it employs; and whether the teachers have natural aptitude or no, their professional skill has either to be acquired at the expense of the pupil, or never acquired at all. No serious person can deny that this state of things is *prima facie* a flagrant absurdity. And when we assert the necessity of training we are not blind to the limits that must be placed on what is to be expected from it. That training alone is not enough: that it will not by itself be able to convert a born incompetent into a good teacher: that some of the most valuable qualities of the teacher are neither taught nor teachable—these are truths which we do not only admit, but insist on; though we may suspect that it is not the untrained teacher who makes the best use of them. I will go further, and assert that training, like other forms of knowledge, may be used in too mechanical a way, and may be too highly valued by its possessor; though I do not assent to the inferences sometimes drawn from these statements. For the teacher innocent of training is at least equally liable to the same dangers. It is quite possible to be ignorant of method, and yet conceited; and it certainly is not necessary to be trained in order to be mechanical. But when all these tendencies and limitations are fully recognised it is obvious, from considerations of common sense and experience alike, that *ceteris paribus*

The Trained Man is better than the Untrained.

As Dr. Fitch said before the Select Committee, 'a poor teacher is made better, a bad teacher can be made tolerably useful, and even the best is improved.' That puts the case in a nutshell; and I do not see what answer there is or can be to it.

I suppose I may assume a general agreement that training, to whatever grade of teaching it is to be applied, will consist of two elements—first, a general education, including, but not confined to, the subjects which the students will have to teach; and, secondly, specific education, both practical and theoretic, in what the Germans call, by the by, the rather terrible name of Pædagogics, but for which I shall prefer to use the easier term Method. It will, perhaps, be simplest and most convenient to take the different branches into which English education naturally falls, and briefly consider them in relation to this definition.

And though it may seem to lie outside our subject, and even outside the region of practical politics altogether, I, nevertheless, should like to begin with

A Word or two about the Universities.

I am aware that nobody has ever ventured to suggest that University teachers should be trained before they commence work; and, more particularly, that when the question of establishing a national register of teachers was, three years ago, brought practically before Parliament by Sir Richard Temple and Mr. Arthur Acland, both these authorities expressly excluded the Universities from the purview of their respective Bills, and in the report of the Select Committee none but school teachers were considered. But though the question has not been raised in public, it is a fair one to raise; and it has certainly been discussed in private. There is in many quarters a suspicion of the Universities—less, I am thankful to be assured, than there was some time ago, and steadily diminishing—but it still, undoubtedly, exists. There is a feeling, none the less injurious because it is vague, that the Universities, though they are powerful by reason of their wealth, prestige, and influence in high quarters, yet are all the while no better than they should be. In view of such feelings, it is all the more important that no reasonable criticism should be shirked, and that any special claim should be justified. Such a critic might be supposed to speak as follows:—'Of the two elements of training, general culture and method, we do not, of course, deny that the University teachers possess the first; if they have it not, nobody has it. But they are professional teachers too, and yet they have

No Apprenticeship or Professional Training of any Sort.

They have difficult subjects and difficult pupils to teach; youths fresh from the class-lists are set to instruct those scarcely younger, in some cases no younger, than themselves; and there are stories from the lecture-room current which imply that the natural results follow. If we are going to insist on training, why should we not begin at the top?'

Now without attributing any weight to the stories which belong, as usual, some to Mythology rather than to History, and some to the past rather than to the present—I may say at once that in my view the principle of training applies here too, and that University teachers, like others, would be the better for systematic attention to method. But, quite apart from the insuperable difficulty of imposing any appropriate system of training, there are one or two points, tolerably obvious but often overlooked, which put a wholly different colour on the situation. It is plain, for instance, that the older and more advanced the student is the more important is the teacher's *matter*, and the less important his *manner*. With the youngest and most ignorant children Method is almost everything; and, though it never becomes indifferent, its relative value visibly decreases as you go up. Again, originality, always most precious in a teacher, in the early stages works best in detail, within the limits of a general system; in the higher studies, it works best unrestricted. Further, it should never be forgotten that University teachers belong to two distinct classes, corresponding to the two main functions of a University, namely, what I may call the Producers and the Distributors of knowledge. Of course all teachers have to distribute, and many do something to produce; but it would not be difficult to classify roughly the University staff under these two heads, according to their predominant activity. And though the producing class may, and do, differ very much in natural power

of exposition, still their value and influence depend mainly on personal gifts and acquirements, and act in a way to which the very idea of training seems inapplicable. With those who are mainly distributors, on the other hand, the case is different; and here the question may be more relevantly raised. But here, too, there is much to remember which is often forgotten, and which makes a difference. First, the students being men, and not boys,

All that Part of Method Relating to Discipline is not Wanted.

Again, the free interchange of teaching between the colleges gives the student a large choice, so that the best teachers are the most sought; and thus the law of gravitation, if I may so call it, reduces the evil, due to a deficiency of method, to a minimum. Further, much of the most important teaching is given *tête-à-tête*, or informally to very small classes; where again personal qualities are all-important, and method would have very little to say. Above all, the Commission of fifteen years ago introduced changes familiar enough to us, but perhaps not fully appreciated outside, which bear directly on this point. The teacher is no longer an Ordinary Fellow of a College, appointed after his degree for his attainments, but an Official Fellow, selected frequently from outside by his special fitness for the work. And the colleges, which have the most cogent reasons for choosing well, have recently shown a remarkable tendency to appoint on their official staff men who have served apprenticeship and can show a good record as teachers. I have counted no less than sixteen of the present Oxford teachers, including some of the most efficient, who have been so appointed in my time, and whose qualifications were both acquired and tested in the public schools or elsewhere. If these men have not exactly passed in Pædagogics, at any rate they cannot be called untrained.

Passing from the Universities to

The Higher Secondary Schools

we are met at once with a paradox. Many very competent judges both at home and abroad are agreed that the English public school more nearly realises the ideal of a sound, efficient, well-balanced system of education than any other extant institution. Without adopting self-complacent superlatives, there is no doubt that the English boy is well-cared for in body and mind, on the whole, in these schools, and that in after life—to my mind the greatest test—he is very loyal to his school, and anxious that his sons should have the same advantages. Of course these schools command every resource; they have money, prestige, tradition, and the best attention of the leisured, powerful and vocal classes; and they can attract the best material both of boys and men. I do not deny—I have the best grounds for assurance—that their boast is not baseless. On the other hand, every one of the teachers is absolutely devoid of professional training. Does not this throw doubt, it may be asked, on the assumption that the training of teachers, even if not equally indispensible for all grades and ages, is nevertheless universally desirable and profitable? The proof of the pudding is in the eating; and if the results are so good without training, is not training superfluous? This question not only *may* be asked, but *is* asked; and if you were to take the staffs of the best twenty public schools, who are confessedly the pick of the Universities, and put the question to them, a large majority of these eminent and select persons would confidently answer 'yes.' I need not say I cordially dissent. The true point is, in my view, not whether these schools succeed, but whether they might not succeed better; whether, in short, there is not *waste*. The first of living headmasters is certainly Dr. Percival; and on this point let me quote him. In answer to the question put to him on the Select Committee by Mr. Acland, how the lack of systematic preparation affected the young teacher, he said:—'Take an ordinary school, in nine cases out of ten the young man goes down from the University and

Plunges into Work without any Definite Preparation

of any kind; so that he starts with his own recollection of school life as his sole equipment, and with nothing more in the way of pædagogic theory and training; and my experience almost invariably was that at first there was *a great deal of waste*. There are all the preliminary difficulties with regard to discipline, and even the best masters often failed in this at first, simply because they did not know how to set about it—*they had never been taught*.' Such evidence as this, from a man who has made a striking success at two great schools, cannot be gainsaid. And the waste of which Dr. Percival speaks covers a vast deal more than the question of form-discipline, important as that is. It affects the whole attitude of mind of the young teacher towards his profession. If he began with an adequate professional training, he would approach his work with some sort of modesty and knowledge, instead of ignorance and confidence. And his experience would be useful to him from the first. It would mean a gradually more assured progress along the right road, from which he had never strayed, instead of meaning, as it too often does now, that he reaches the right road ultimately in a somewhat battered condition, after a series of futile excursions down blind alleys.

But, important as are the higher public schools, from many reasons, and wide as is the attention which they command, we must never forget that they form an insignificant fraction even of the inadequate supply of secondary schools which we possess. The College of Preceptors, which (pending the researches of the new Commission) has the best and fullest information about our secondary schools, calculates that there are about

780,000 Children receiving Intermediate Education in about 11,000 Schools,

and that of these the public and proprietary schools number not more than 1,000, the remaining 10,000 being in private hands. In all these, the number of teachers who hold any sort of professional diploma is lamentably small; and of those who do, by far the most important section are the trained and certificated primary masters who have transferred their energies to secondary teaching. The Endowed Schools have, no doubt, immensely improved since the days of the old Commission, and even among the private schools there have been strides of progress. The most intelligent private teachers have, for close on fifty years, been active, not only in cultivating their own corner of the field, but in uniting for the promotion of reforms to improve the rest. In the demand for training, in particular, they have been long to the front, thereby contrasting creditably with the supineness of the more highly-favoured public schools. And I must note in passing, that it is one of the most reassuring results of the improved education of women, to find how promptly they have perceived the importance of training, and almost as a body have thrown their weight into the demand for it. Nevertheless there is no doubt that far the worst consequences of our *laissez faire* in secondary education are still, as ever, to be found among the lower ranks of these ten thousand private schools. I know myself of places where they have no real teaching or teaching-power, no system, no ideal, and of course no inspection, training, guarantee, or test of any kind; where it is hardly too much to say that the whole energies of the place

Are Devoted to Gulling and Exploiting the Parents.

Dr. Wormell, of the City Middle-Class Schools, who receives about 30 per cent. of his boys from private teachers, says that though some of them have been very well taught, a good many have been *very badly taught indeed*, and the mischief done to them by unqualified teachers *is nearly irreparable*. The same authority speaks plainly of the private schoolmasters 'purchasing bogus degrees,' and records the case of one such gentleman who printed a variety of letters after his name, amongst them being the well-known letters A.M. When he was pressed to explain these, he said they stood for *Art Master*, a degree awarded by himself for teaching drawing in his own school!

We have here a miscellaneous set of evils which doubtless cannot be met by one remedy. Between the *bonâ fide* man who wastes power and time for want of training, and the absolutely unqualified and fraudulent humbug, there are plainly many intermediate degrees of unfitness.

The First Step to take is certainly Registration.

This would be promptly fatal to the worst mischiefs, and would, undoubtedly, promote, though it would not of itself necessitate, more general training. At first we might probably have to accept degrees, and even experience, as qualification; and this, in the higher schools, would leave things pretty much as they are. But we ought never (in my view) to be permanently content with anything short of universal compulsory training. As long as it is left optional, even if it became vastly commoner, some of the best would escape; the training colleges would still complain, as they all do now, that they do not get the best material. The cleverest beginners can get places at once; and it tends to be the weaker vessels and the failures who are driven to eke out inferior qualifications with a training certificate. Even so the principle is justified, for they are vastly improved by training, and enabled to compete with their natural betters. But this is obviously not what we want; the best oars must be trained as well as the feebler folk, or we shall be pulling at half power.

In spite, then, of the opinion of teachers of all ranks, of every conference, meeting, congress, and association; in spite of the experience of every foreign nation, to which I have no space to refer; in spite of strenuous isolated efforts in practice, among which none have been more striking or successful than those of the women; the English secondary teachers, from top to bottom, still suffer from one vital defect, the entire want of systematised professional preparation. Of the two sides of training which we have assumed—knowledge and method—the knowledge is more or less adequately present; the method is, with the rarest exceptions, absent.

And in the primary training, I would ask, in conclusion, is not the case reversed? The specific professional training has been adequately realised, that is the strong point; but is not the weak point a comparative deficiency of the other side, the general education? It will, of course, be understood that I speak with the greatest caution and diffidence—my whole direct experience lies in the higher and intermediate branches; but I wish to ask for information, and to put the case as it appears to me. May it not then be said, without much exaggeration, that culture and method being necessary for all school teachers, our system has resulted in giving

To Secondary Teachers some Culture but no Method: and to the Primary Teachers adequate Method, but defective Culture?

I have myself talked to very intelligent men who have been through the training college and afterwards entered at the University, and who were deeply convinced of the narrowing effects of the system. Mr. H. Ll. Smith, who studied the question in Scotland, reports that all the authorities whom he consulted seemed convinced of the narrowing influence of a mere training college course, especially in the case of a residential college. And the same report adds, that the system of training which is combined with a University course is admitted by all to be far superior to a course at the normal school. There is evidence from abroad which points in the same direction. In Germany the training course is six years, in both general education and method; and there is a strong movement now to devote the whole of the first four years to general culture, and leave the professional part to the last two. In France, where the professional training seems distinctly inferior to ours, the general education, especially on the literary side, is allowed to be wider and better. Mr. Ward, a training college teacher, and a distinguished Oxford man, writes as follows: 'While here our students at most read a play of Shakespeare, some essays of Bacon, and a novel of Sir Walter Scott, in France almost all the classical writers are read.' And again, on language: 'Free from the necessity of preparing carefully a single book, which takes up almost the whole of the English students' energies, the Frenchman can study his languages in a more varied and interesting way.' And is there not some connection between this defect and the following description by a master who has much experience in teaching ex-primary and secondary children together? 'A boy from an elementary school, who has passed the Sixth or Seventh Standard, is generally very accurate in all the work he does; he objects, however, to enter into oral arguments; he prefers to answer all questions in monosyllables, and his general knowledge outside the subjects taught in the school is often rather limited; *one has to devote six months to open out his mind.*' These are the words of Dr. Wormell, in his evidence before the Select Committee on Registration. The suggestion is that if the teachers' training were wider, the pupils would be better off. Perhaps too much is expected, and we ought never to expect too much. Something is, no doubt, traceable to our apprenticeship system. I should like to hear

Wm. Geo. Constable

The Candid Opinion of the Conference on the Pupil Teacher Question.

The latter surely are overworked. I heard a very able Extension lecturer the other day, who had taught many hard-working people, say that the pupil teachers he taught were 'utterly jaded and played out.' The Inspectors complain of bad reading, unintelligent reciting, meagre and narrow text-books, mechanical arithmetic, and general lack of life. The masters complain of want of time to teach the students properly; and no doubt the complaint is often just. The training colleges complain that the first year is largely spent on elementary work that ought to have been done before. Without attempting to appraise or sift these various recriminations, one may feel that there is a defect somewhere. And the recent drift, both of changes and opinions, seems to point in the direction indicated. The demand for the accommodation of the syllabus to the London University course; the granting of the third year; the establishment of Day Training Colleges; the association of teachers to promote connection with Universities; all these seem to have a common aim. I am aware that there is still, as I said above, much suspicion of Universities among the teachers; and Dr. Rigg, in his address this year at the inaugural meeting of the Wesleyan Colleges, goes as far as

To Dissuade Students from University Residence altogether.

He says it would be 'a radical mistake,' and the student would be 'running a great risk of unfitting himself' for the work of an elementary teacher. I can only say, I should be very sorry to believe that these fears were well grounded. I should be rather inclined, on the contrary, to look forward to a large extension of the Day Training College system, in which the secondary teachers might find a place side by side with the primary. This is not a mere amateur suggestion, for I see that such high and independent authorities as Dr. Fitch, Professor Laurie, and Dr. Wormell unite in recommending it. But in any case, whatever steps be taken to remedy it, the defect itself demands attention from all of us. I cordially agree that on this point, as on all others that affect national education, the voice of the teachers should be heard. And when I say teachers, I mean, first and foremost, the teachers mainly concerned; but also, not less certainly, the teachers in other branches.

For we are all one Profession,

and we want light on our difficulties from every quarter. And I cannot better sum up the whole issue than in the excellent words of the Department Instructions of two years ago—words intended for the primary teachers, but applicable to all of us: 'The future usefulness of the teacher depends, not only on what he knows and can do, but on what he *is*—on his tastes, his aims in life, on his general mental cultivation, and on the spirit in which he does his work. Although such qualifications cannot be formulated in a schedule, or made the subject of examination, they are nevertheless indispensable as conditions of all true improvement in national education.'

WELL-KNOWN TEACHERS AT WORK.

XXIX.—MR. WILLIAM GEO. CONSTABLE, B.A.

Gerard Street Higher Grade Board School, Derby.

THE town of locomotives can boast of not a few well-built and well-equipped educational establishments, and among these the Higher Grade Board School is to be numbered. Early on a certain Tuesday morning we gathered our stock of interviewing

queries and booked to Derby by the Midland express, to interview that redoubtable 'Old B.,' W. G. Constable.

Conventionally he is an 'Old B.'—it is a well-accredited tradition that no man left 'the Borough' without becoming an 'Old B.'—but, as a matter of fact, he is very young looking, albeit the beard he is just now sprouting has added a cast of gravity to his appearance. Tall, of exceeding gentleness and grace of manner, courteous to a degree rarely met with in these latter days, W. G. Constable is by nature moulded for the place he occupies day by day amongst the young.

But to a charm of manner that almost suggests—what is very far from the truth if you ruffle his sense of probity and honour—effeminacy, W. G. Constable adds a rectitude of character, a stern and rigid adherence to the truth wherever it is to be found, and a scrupulousness of mind that puts the average man to shame. In our monthly peregrinations to and from London we invariably spend the week end with our fellow-assistant and colleague of the Executive, Mr. Macnamara of the *Schoolmaster*, and it is our wont, in the small hours of Saturday night, after the long day at Russell Square, to talk over persons and things connected with the profession and Union.

Often have we watched the smoke curl from the doughty 'Mac's' cigarette, and listened as he clenched the matter in his own *ipse dixit* style. 'Well, there are two men I know whose conscientiousness simply knocks me out. One is Gilbert Christian, and the other Will Constable. Of anything like moral elasticity of mind there doesn't exist the faintest trace in their constitutions.' And the criticism is a true one — certainly in Mr. Constable's case, as no doubt it is in Mr. Christian's.

Mr. Constable was head of his year in the Borough in 1881, and every man jack of the 65 men 'in' with him will tell you that Constable was an almost painfully 'straight' fellow.

A brilliant student, quick as mercury, steady as granite, and one of the best read amongst a company of well-read men, 'Will' Constable's record, Old B.'s tell us, is as distinguished as any man's amongst them. He has gone far in these short years, as we intend to show. Everybody who knows him is confident that he will go further, given health and strength.

As Mr. Constable cordially greets us, he asks, 'What enemy hath done this?' with a merry, good-natured twinkle.

'You will see that we are still in a state of evolution,' says Mr. Constable. 'The school consists of three departments—Organised Science School, Boys' School for Standards III. to VII., Junior Mixed School for Standards I. and II. The standards are divided into upper and lower divisions. There are 19 teachers on the staff, and all save one are certificated teachers. One is an Art Master, another is employed solely in teaching Chemistry, and several of them are undergraduates of London University. In the Organised Science School we take a three years' course of instruction in Science, Art, and Commercial Subjects; and in the Boys' School we take the usual subjects of the Education Code, with French. The boys take Algebra and Shorthand, and the girls Cookery. The sharper children are allowed to take up two Science Subjects.'

'But let me show you the children at work,' says our friend, 'and we can talk over these details as we go round.'

And very soon we are in an admirable Lecture Theatre capable of holding 250 students. Such a room, with its isolated seats and desks, huge blackboard and table for demonstration by experiment, exhibits the feature that runs through the school—practical utility in all things.

'We can darken the room for illustrating by means of the lantern,' says Mr. Constable. 'And here is our Preparation Room, wherein the materials for the experiments are arranged.'

And as we pass into the next room, which is in a state of incompletion, the Old B. looks somewhat serious as he exclaims, 'This is to be our Physical Laboratory. It always seems absurd to me that South Kensington should encourage and recognise Practical Chemistry, and refuse to assist the teaching of Practical Physics. However, I am glad to say that the Derby School Board has a wider view of the utility of such teaching than is to be found within the covers of the *Science and Art Directory*, and has therefore given me a free hand in organising and fitting up this room for teaching Practical Physics.'

'Like most successful Higher Grade Schools, your school seems to have developed from the Primary School by natural stages.'

'Quite true,' says Mr. Constable. 'I believe in the old proverb, "Make haste slowly." A well-equipped and organised Science School cannot be turned out in a day. I have been sent by the School Board to most of the Higher Grade Schools of the country, in order that we might avail ourselves of

the practical experience of others. These visits were of great benefit to myself and the Board. Our fixtures and apparatus bear evidence of suggestions gathered, and we have had little to undo and no steps to retrace.'

A complete skeleton reminds us that man is of the earth, earthy.

Somebody has dubbed the Chemical Laboratory 'the little gold mine' of the Organised Science School. The cognomen was intended to be by no means complimentary. But as I look on this *El Dorado*, and note the interested industry of the half-hundred boys analysing salts under the guidance of Mr. West, one feels with Byron, 'Ah! happy years! once more who would not be a boy?'

The laboratory contains every convenience, and practical forethought has done much to prevent disorganisation. The outlet pipe in every basin can be repaired without disturbing the other benches. The visitor is not suffocated by fumes of H_2S. The names on the bottles are ground into the glass, and everywhere there is order, cleanliness, and practical experience manifest.

'Paper labels are cheaper,' says Mr. Constable, 'at first, but in the end the Board will find that the inscribing of the name will repay. We teach Science all the year round. I don't believe in making the be-all and end-all the grant from South Kensington. The Board accepted my advice in the first instance, and did not expect me to turn the Science teaching into a mad rush after grants. Of course we must, under present conditions, earn grants; but I hope the day is not distant when we shall abolish "payment by results" from the Science Schools.'

'Do the fees debar any number of children?'

'No, I think not. The Board awards Free Scholarships upon the results of an examination held each April, and the Derbyshire County Council's Technical Scholarships are tenable here.'

'Your children come from good homes, as a rule, I should think?'

'That is true of all schools of this character. The parents take great interest in the work of the school—an interest which we endeavour to foster. Every Christmas we have an "Open Day." On this day the ordinary work of the school is arranged to allow the parents to see a great variety of subjects. The Open Day has been so successful that we have had to restrict the invitations somewhat. Here is our last year's circular:—

Derby School Board,
Higher Grade School,
Gerard St. and Abbey St.
December 9th, 1893.

OPEN DAY.

DEAR ——,

We have, with the concurrence of the Board, decided that Tuesday, December 21st, shall be an 'Open Day' at this school.

The work will be arranged so that a class will be held in each subject of instruction at least once during the day.

The school will be open from 2.15 to 4.15, and you are cordially invited to be present.

We are,
Very faithfully yours,
WM. GEO. CONSTABLE,
MARGARET J. KEAY,
ELIZABETH CHAPMAN.

Please Note.—(1) That you will be admitted only upon production of this letter of invitation. (2) That each letter of invitation will admit two. (3) That no children will be allowed to enter.

HIGHER GRADE BOARD SCHOOL,
GERARD STREET.

Head Teachers.

Boys' and Junior Departments	Mr. Wm. Geo. Constable, B.A., B.Sc. (Int.), Lond.
Girls' Department	Miss M. J. Keay.
Infants' Department	Miss E. Chapman.

OPEN DAYS.

Classes will be held as follows:—

Ordinary Subjects.—Reading, Writing, Composition, Letter-writing, Arithmetic, Mental Arithmetic, Recitation, Parsing, Analysis, Geography, Mapping, Printing, Singing, Theory of Music, French, and Shorthand.

Drawing.—Building Construction, Machine Drawing, Model, Freehand, Geometrical, Scale, and Shading from the Cast.

Science.—Mathematics, Theo. Mechanics, Sound, Light, and Heat, Magnetism and Electricity, Physiography, Physiology, Hygiene, Botany, and Chemistry.

Drill.—Swedish, Dumb-bell, Wand, Flag, and Ring, all accompanied by Music.

Kindergarten occupations.

Technical Subjects.—Modelling in Clay, Cookery, Practical Chemistry, Needlework, Knitting, and Cutting-out.

The Departments, &c., are situated as follows:—

Abbey Street—	
Senior Boys' Department	Ground Floor & First Floor.
Organised Science School	First Floor & Second Floor.
Laboratories & Lecture Theatre	Second Floor.
Art Room	First Floor.

Modelling in Clay, Shading from the Cast.

Central Hall	First Floor.
Cookery School	Ground Floor.
Gerard Street—	
Senior Girls' Department	First Floor.
Junior Department	Ground Floor.
Infants' Department	Ground Floor.

An Exhibition of School Work will be held in connection with each Class.

COOKERY SCHOOL.

Instructor — Miss R. Hancock.
(*Diplomée S.K. School of Cookery*).
A Class will be at work from 2.15. to 4.15.

CHEMICAL LABORATORY.

A Class of Boys will be at work from 2.15 to 4.15.

A Demonstration of Ambulance Work will be given by the Hygiene Class.

The Head Teachers hope Visitors will kindly remember this is an 'Open Day,' and that they are asked to go from room to room as they may wish.

Besides being a splendid advertisement, it gives one the opportunity of coming into personal contact with the parents; and, what is still better, brings the parents in close touch with the work of the school and the class teachers.'

'Of course your scientific side gives you a good supply of "fireworks" on such an occasion?'

'Quite true; but before I had the Higher Grade School I had an Open Day. As you suggest, a school of this kind is at a great advantage in providing a good show.'

And as we leave the children with their 'salts,' Mr. Constable says how great a relief it is to him to have this part of the work practically off his hands.

The Cookery School is in charge of Miss R. Hancock. It is in the basement of the building, and is admirably adapted for the purpose. For a few pence the children can get a substantial dinner—a matter of very great importance when it is remembered that the children come from all parts of Derbyshire.

'I not infrequently dine here myself,' says Mr. Constable.

'Every morning, before eleven, every scholar who wants dinner buys a check, and I send down the number to Miss Hancock.'

We leave Miss Hancock, promising to return, if time permits, to taste the dishes, and visit the Senior Boys' Department, where Mr. Peel shows us some Mechanical Drawing executed by the scholars. These have been submitted to South Kensington, and grant awarded for them. Remembering the Midland Railway Works is located in Derby, we suggest that this is by no means the least important part of the school curriculum.

'I am somewhat proud of those drawings,' says Mr. Constable, 'not only because they bear the *imprimatur* of the Department, but because I feel that we are equipping these boys for future success in the employment of the Railway Company, where many of them must spend their future. It is a phase of our work which I hope to see greatly developed.'

As we turn our steps toward the Art Room, I express my surprise at the magnitude of the place.

'That is the result of the adaptation of the old school. In 1888 the Board determined to make this the Higher Grade School, and transferred me from the old Derby British School, which had been under the Board since 1886. Step by step we have arrived thus far. Had a new school been built we might have been more compact, but there is not much left of the old premises.'

The Art side consists of two rooms—one for drawing, and the other devoted to clay modelling. Everything is up to date. By night or by day the influx of light can be regulated. A novel kind of portable folding-desk is used.

'I believe in Manual Training,' says Mr. Constable; 'and a wood-working room is being arranged for the Senior School. In the Junior Mixed School I hope to introduce card-board work. The mistress there holds special qualifications.'

'Working under such conditions, I presume you are not deeply interested in superannuation?'

'True, the conditions are better than those which obtain in most schools, but the work is as hard. It is certainly more satisfactory, since we get the children to remain at school for a longer time. I am very anxious to see a satisfactory State-aided scheme of superannuation established.'

'In the event of the Government organising Secondary Education, do you anticipate an influx of Secondary Teachers?'

'Large numbers of teachers are graduates of London and other Universities. This number will

ROUTINE.

DERBY.—GERARD STREET HIGHER GRADE BOARD SCHOOL.

ORGANISED SCIENCE SECTION.

	Time.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.
First Year's Course. Class A.	9—9.30	Religious Instruction	Religious Instruction	Religious Instruction	Religious Instruction	Religious Instruction
	9.30—10	Shorthand	Shorthand	Shorthand	Shorthand	Shorthand
	10—11	Subject V.—Stage I.	Subject V.—Stage I.	Subject X.—Elementary	Geography (England)	Subject V.—Stage I.
	11—12	Subject X.—Elementary	Letter Writing	Subject V.—Stage I.	Subject V.—Stage I.	Subject X.—Elementary
		Interval.	Interval.	Interval.	Interval.	Interval.
	2—3	French	Geometrical Drawing	French	Arithmetic	French
	3—4	Geometrical Drawing	Subject XP.—Elementary	Freehand	Subject XP.—Elementary	Geometrical Drawing
	4—4.30	Reading (Shakespeare)	Subject XP.—Elementary	Rdng. ('Citizen' Reader)	Subject XP.—Elementary	Reading (Shakespeare)
First Year's Course. Class B.	9—9.30	Religious Instruction	Religious Instruction	Religious Instruction	Religious Instruction	Religious Instruction
	9.30—10	Shorthand	Shorthand	Shorthand	Shorthand	Shorthand
	10—11	Subject V.—Stage I.	Reading, 30 m. / Subject XP.—Elementary	Subject V.—Stage I.	Reading, 30 m. / Subject XP.—Elementary	Subject V.—Stage I.
	11—12	Subject X.—Elementary		Subject X.—Elementary		Subject X.—Elementary
		Interval.	Interval.	Interval.	Interval.	Interval.
	2—3	Geometrical Drawing	Subject V.—Stage I.	Freehand	Geometrical Drawing	Geometrical Drawing
	3—4	French	Arithmetic	French	Arithmetic	French
	4—4.30	Geography (England)	Letter Writing	Rdng. ('Citizen' Reader)	Geography (England)	Letter Writing
Second Year's Course. Class C.	9—9.30	Religious Instruction	Religious Instruction	Religious Instruction	Religious Instruction	Religious Instruction
	9.30—10	Shorthand	French	Shorthand	French	Shorthand
	10—11	Subject X.—Advanced	Mechanics— / Modelling in Clay and Shading from Cast	Subject V.—Stage II.	Subject VI.—Elementary / Modelling in Clay Light and Shade	Subject X.—Advanced
	11—12	Subject I.—Elementary		Subject X.—Advanced		Subject I.—Elementary
		Interval.	Interval.	Interval.	Interval.	Interval.
	2—3	Subject V.—Stage II.	Subject V.—Stage II.	Subject II.—Elementary / or / Subject III.—Elementary	Subject V.—Stage II.	Subject V.—Stage II.
	3—4	Subject XP.—Advanced	Subjects VIII. & IX.		Subjects VIII. or IX.	Subject XP.—Advanced
	4—4.30	Subject XP.—Advanced	French		Subject V.—Stage II.	Subject XP.—Advanced

Registers marked at 11 a.m.; 3 p.m.

DERBY.—GERARD STREET HIGHER GRADE BOARD SCHOOL.

SENIOR BOYS' DEPARTMENT.

ROUTINE.

All.	9—9.10	Open School with Singing and Prayer.
	9.10—9.30	Scripture Lesson. Hymns. Repetition.
	9.30—9.40	Mental Arithmetic.
	9.40—10.25	Arithmetic.
	10.25—10.40	Singing—Theory and Songs.

—	Time.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.
Standard VII.	10.40—11.20	Reading	French	Reading	French	Reading
	11.20—12	Dictation	Composition	Composition	Composition	Dictation
	2—2.40	Grammar	Geography	Mapping	Grammar	Geography
	2.40—3.20	Shorthand	Drawing	Shorthand	Drawing	Shorthand
	3.20—4.0	Algebra	Drawing	Algebra	Drawing	Algebra
	4—4.30	French	Grammar	Recitation	Geography	French
Standard VI.	10.40—11.20	Reading	French	Reading	French	Reading
	11.20—12	Composition	Dictation	Composition	Dictation	Composition
	2—2.40	Grammar	Geography	Mapping	Grammar	Geography
	2.40—3.20	Shorthand	Drawing	Shorthand	Drawing	Shorthand
	3.20—4	Algebra	Drawing	Algebra	Drawing	Algebra
	4—4.30	French	Grammar	Recitation	Geography	French
Standard V.	10.40—11.20	Reading	French	Reading	French	Reading
	11.20—12	Composition	Dictation	Composition	Dictation	Composition
	2—2.40	Grammar	Geography	Mapping	Grammar	Geography
	2.40—3.20	Dictation	Drawing	Reading	Drawing	Dictation
	3.20—4	Algebra	Drawing	Algebra	Drawing	Algebra
	4—4.30	French	Grammar	Recitation	Geography	French
Standards III. & IV.	10.40—11.20	Reading	Grammar	Reading	Geography	Reading
	11.20—12	Dictation	Reading	Dictation	Reading	Dictation
	2—2.40	Grammar	Geography	Geography	Grammar	Geography
	2.40—3.20	Copy Books	Drawing	Reading	Drawing	Copy Books
	3.20—4	Elementary Science	Drawing	Elementary Science	Drawing	Arithmetic
	4—4.30	Arithmetic	Dictation	Recitation	Dictation	Grammar

Registers to be closed at 10 *and* 2.30.

JUNIOR MIXED DEPARTMENT.

ROUTINE.

All.	9—9.10	Open School with Singing and Prayer.
	9.10—9.30	Bible Lesson.
	9.30—9.45	Mental Arithmetic.
	9.45—10.20	Arithmetic.
	10.20—10.35	Singing.
	10.35—10.50	Play.
	10.50—11.25	Reading.
	11.25—12	Dictation and Spelling.

—	Time.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.
Boys. Standards I. & II.	2—2.40	Grammar	Geography	Geography	Grammar	Geography
	2.40—3.20	Copy Books	Drawing	Elementary Science	Drawing	Copy Books
	3.20—4	Elementary Science	Drawing	Recitation	Drawing	Grammar
	4—4.30	Dictation	Drill	Singing	Drill	Dictation
Girls. Standards I. & II.	2—2.40	Needlework	Geography	Needlework	Grammar	Needlework
	2.40—3.20	Needlework	Drawing	Needlework	Drawing	Needlework
	3.20—4	Grammar	Drawing	Recitation	Drawing	Geography
	4—4.30	Drill	Copy Books	Singing	Copy Books	Drill

increase as the Day Training Colleges succeed. The Primary School teacher is without doubt the superior of the Secondary School teacher in practical skill. With a large sprinkling of University distinctions and the practical ability, the Primary School teachers need not fear the Secondary teachers.'

'How could Science teaching in your schools be improved?'

'We want abolition of payment by results. There ought to be a fixed capitation grant, and inspection substituted for examination. It is surprising how slow the Science and Art Department is to meet modern demands. Many of my children come from outside Derby. The Science Examinations finish at 10 p.m. At that time it is impossible for them to get home, as the last train has gone. We are compelled to arrange for them to stay overnight. Yet the Department cannot arrange for these children to be examined in the daytime.'

'And now about the working of so complex a school.'

'As regards the school work, the school year is divided into working months of four weeks each. The class work for each month is arranged jointly by the class teacher and myself. At the end of the month the classes are examined, and the individual results recorded. The class teacher and I then go through the examination work together, and in the light of knowledge so gained the next month's work is set. We endeavour to arrange the work so that two working months are left for revision. The monthly result lists are kept till the close of the school year, and afford a basis for determining whether a scholar shall go forward or not. Working thus, we find ourselves able to classify our scholars accurately without difficulty. Except in Drawing, we have not yet been able to take advantage of the power to classify separately for each subject.'

Mr. Constable was a P.T. for five years, the first two being spent in a British School, and the last three in a London Board School. In 1880 he entered the Borough Road Training College, being 'top man' in 1880 and 1881.

'Yes,' says Mr. Constable, 'my *vis-à-vis* in the Dining Hall was a somewhat loquacious individual of the name of Macnamara. You may have heard of him.'

During 1882 he was in charge of the Lower Division of the Practising School attached to the College, and in 1883 re-entered the College as an Assistant Tutor, being engaged principally in teaching Chemistry and Mathematics.

In 1886 he was appointed by the Derby School Board Head Master of the well-known Derby British School, which was about to be transferred to the Board. In 1888 the Board decided to make Gerard Street Board School a Higher Grade School, and our subject was transferred from the British School.

Mr. Constable has graduated in Arts at the London University, and has also passed the Intermediate Examination for the B.Sc.

He is a thorough Unionist, being V.-P. of the Derby Association. A shrewd and practical speaker, he has generally a word to say at the Easter Conference, and it is generally a word in season. But perhaps he is to be seen at his best at the Borough Re-union.

'And now, Mr. Constable——'

'And now we'll go and interview Mrs. Constable, if you don't object, for it is past twelve, and dinner waits,' says Mr. Constable.

And I hide my note-book and hie me to enjoy the hospitality of Mrs. Constable, which makes me ask, 'Who would not a interviewing go?'

ELEMENTARY LESSONS IN HORTICULTURE.

BY PROFESSOR J. R. GREEN, M.A.,
Late Examiner in Botany to the University of Cambridge, and
F. L. GREEN,
Late Science Mistress in the Clifton High School.

VII.—Fruits and Seeds and their Distribution.

(*Continued.*)

Various directions are assumed by the ovule. When, as in the dock, it grows up from the bottom of a chamber of an ovary, it is called *erect*. In the buttercup it is *ascending*, directed upwards; while in the rose it is *pendulous*, hanging downwards. In the anemone the ovule hangs down from the top of the ovary chamber, and is said to be *suspended*. In the lily it is *horizontal*.

The formation of the oosphere, or egg-cell, of the ovule has already been described under the heading of the flower, and we have seen that fertilization—the fusion of the nucleus at the end of the pollen-tube with the nucleus of the oosphere—takes place, speaking generally, through the agency of the wind or insects. As the result of fertilization changes occur in the oosphere, nucellus, integuments, and carpels. After fertilization the oosphere proceeds to surround itself with a cell wall, and commences to elongate in the direction of the axis of the ovule. By the process of division the resting plant, or embryo, the nature of which has been described in our consideration of the process of germination, is formed. In many families of plants—such as the Crucifers or Cross-worts, and Leguminosæ, the Pea and Bean Tribe—the embryo fills up the whole space inside the testa, or seed-covering, developed from the integuments of the original ovule, the cells of the nucellus being absorbed. In the grasses, carrot, &c., the embryo only occupies a portion of the space enclosed by the testa, the rest of the space being occupied by the nutritive substance *albumen*, which is called *endosperm* when produced in the embryo sac, and perisperm when originated outside it. Enlargement and other changes take place in the carpels, forming fruits.

The phenomenon of germination having been fully described in the first chapter, we may now examine the agencies by which fruits and seeds are distributed. They may be scattered abroad through the instrumentality of the plant itself, by water, by wind, or by animals.

Seeds are distributed in many instances through the elasticity of the fruit, which may either be a splitting fruit, or dry and dehiscent. A good example of the former is furnished by the geranium. The axis of the fruit is there prolonged into a kind of beak, and five thin elastic strips of tissue attach the five distinct lobes which form the fruit to the beak. When the fruit is ripe these strips suddenly curl up, sending the lobes to a considerable distance.

In the broom, each half of the pod as it dries strives to twist into a spiral; and, at last, when the tension becomes too great, the pod splits violently open, scattering the seeds. A very common weed—the hairy bitter cress—has a siliqua whose valves fly open from below at the slightest touch, occasioning a brisk discharge of the seeds. In the violet the capsule splits widely open into three valves, each containing a row of seeds on a parietal placenta. As the valves dry, they curl up and press against the seeds, ultimately jerking them to some distance, just as a fruit stone may be shot from between the thumb and finger. In the eschscholtzia—a common garden flower—the valves curl outwards from below upwards, and cast out the seeds.

In some exploding fruits the exploding force is due to turgescence, as in the squirting cucumber of South Europe, the wild balsam (Touch-me-not), found in some parts of Yorkshire and Westmoreland, and the wood-sorrel. In the squirting cucumber the walls of the fruit swell, exerting so strong a pressure on its contents that rupture takes place at the base, and the fluid contents, mixed with seeds, are violently ejected. In the wild balsam the valves of the capsule swell, and try to curl inwards. On being touched they immediately assume a spiral form, and spring with some force many feet from the plant, throwing the seed in all directions. In the wood-sorrel each seed is enclosed in a fleshy turgescent case in such a state of tension, that it is constantly striving to strip itself off the seed and turn inside out. When the fruit is ripe, a slight disturbance of the capsule is sufficient to bring this about, and the seeds are, in consequence, violently thrown to a distance.

Water is an important agent in the distribution of seeds, especially such as are enclosed in a covering which is water-tight, and at the same time light enough to make the seed float. Seeds and fruits when thoroughly dried, especially if attached to branches, have been found to float for a considerable time. The seed of a leguminous plant—a native of the West Indies—has been cast on the shores of Ireland and of Cornwall in a fit condition to germinate. Floating timber and floating ice aid in the distribution of seeds by water. Uprooted trees are often carried great distances by ocean currents, and in the cavities among their roots are stores of earth frequently containing seeds. Icebergs have been known to carry earth on their surface; and in river ice, partly consisting of 'ground ice,' we have another possible means of transport for the seeds of water plants.

It is obvious that the wind plays a very important part in the distribution of seeds. Seeds, indeed, that are not in any way adapted for flight, are occasionally blown by whirlwinds or by hurricanes, the latter being capable of travelling at the rate of ninety miles an hour. Many seeds—*e.g.*, those of orchids—are small and light enough to float in the air like dust. Such small seeds sometimes occur in capsules opening by pores, examples of which we have found in the poppy and snap-dragon. The pores being situated near the top of the capsule, the seeds cannot fall out of their own motion, but are shaken out by the wind. This means of distribution has been called the 'cause mechanism.' Another example of it is afforded by the larkspur, where the ripe seeds lie loose at the bottom of the open capsules, which are swayed by the wind, thus scattering abroad the seeds. In the campanula the capsule is pendent, and the censer-holes are at the base.

The floating power of seeds is sometimes increased by peculiarities of shape, increasing their surface without materially adding to their weight. This is the reason of the flat seeds of the iris and tulip, and the bordered seeds of the rock plant, Golden Dust (*Alyssum*). Bordered seeds have been proved by experiment to be much more capable of aerial distribution than compact seeds. When a number of seeds—some bordered, some compact—were placed on a glass plate, an artificial wind was found to carry the bordered seeds three times as far as compact seeds of equal weight.

Many fruits and seeds are fitted for aerial distribution by the presence of wings. We have already referred to the winged fruit, *samara*, of the sycamore. Here part of the fruit itself serves as a wing. In the lime and hornbeam a bract serves this purpose. In the thrift, whose rose-coloured flowers are to be frequently found on the sea-shore, the dry, chaffy calyx serves the fruit as a wing. An example of winged seeds may be found in the Scotch fir.

The most perfect of flying mechanisms is found in the development of hairs acting as a parachute. This is the explanation of the *pappus* found in the lettuce, dandelion, thistle, everlasting, and other allied plants. Here the calyx is represented by a crown of hairs surmounting the fruit, and enabling it to be readily blown away. On the seeds of the willow and the willow-herb, a wild congener of the evening primrose of our gardens, hairs are grouped into tufts at one end of the seed, forming a kind of beard, which materially aids it in its flight. The fruit of the clematis has a long feathery beak, or awn, adapted for catching the wind.

Before passing to the consideration of the share taken by animals in the distribution of fruits and seeds, it must be remembered that some wind-distributed fruits do not fly through the air, but roll over the surface of the ground. The puffed up calyx of the winter cherry probably acts in this way. In the 'Rose of Jericho' the whole plant is said to roll like a ball over the surface of the desert. In the region from Syria to Algeria, the habitat of this plant, there is a long dry season every year. The leaves of the 'Rose of Jericho' fall off while the seeds are ripening, and the branches fall inwards, reducing the whole to a ball, which is easily loosened from the dry ground, and blown bodily along by the wind. When the ball comes under the influence of moisture, either by being driven into water, or through the arrival of the wet season, the branches unfold, and the capsules open and shed their seeds.

Animals take an important share in the distribution of plants. From a ball of earth, which was found adhering to a wounded partridge, no less than eighty-two seedlings sprang up. Again, many seeds and fruits form part of the food of birds and certain quadrupeds, and germinate after being voided by them. The fruits of grasses, *e.g.*, have been found in the dung of locusts in a fit condition for germination, and these insects are sometimes blown to great distances, thus affording an efficient means of transport. Seeds have, indeed, been found in the crops of such a marine bird as the stormy petrel.

Certain fruits and seeds possess special appendages fitting them for transport through the agency of animals. They may have hooked processes, when they are properly called *burrs*, or they may adhere to the coats of birds or quadrupeds in consequence of sticky hairs or their glutinous surface. Speaking generally, we may say that burrs occur on low-growing plants, not on trees, for they are specially adapted to adhere to hair, not to feathers, and quadrupeds form their chief agents of transport. The sticky fruit of *Pisonia*, on the other hand, has been found, by a traveller in Keeling Island, to adhere to the feathers of herons in such quantities as to cripple them, and in some cases to cause the death of the bird. In the plumbago, a plant that may be found on any common, the calyx is persistent, and its viscid, glandular hairs make the fruit adhere to the coats of animals brushing against it.

Burrs, however, form a more efficient auxiliary than mere stickiness. Some of them are so common in wool as to receive special names from wool merchants, and greatly depreciate the value of the wool. At Montpellier, where foreign wool is spread out to dry, many hundred species from Spain, Northern Africa, Italy, and Southern Russia are recorded to have been introduced in this way; and a wool-burr, *Xanthium*, has gradually travelled, through its adherence to the hair of animals, from the East to the West of Europe. In 1828 the Cossack horses, whose manes and tails were covered with these burrs, introduced the pest into Wallachia. In Hungarian wool and cattle it travelled on to Hamburg. Another efficient burr is found in the fruit of *Stipa* and other allied grasses, which end in a sharp point armed with reflexed hairs, enabling the fruit to bury itself. It has been found in Australia and elsewhere to work its way through the skin of sheep and enter the body cavity, embodying itself in the viscera. The globular seed-vessels of the common hedge-plant, the goosegrass or cleavers, are an excellent example of burrs. They are very tenacious, cleaving to the coat of any animal that touches them, and the plant is eagerly devoured by geese. Another easily consulted instance of burr distribution occurs in the common burdock of waste places, whose round heads of purple flowers are inclosed in a globular involucre of hooked scales which readily adhere to the coats of animals.

In connection with animal distribution we must briefly mention the interesting question of attraction. Fruits are found to develop bright colours, sweet odours, and sugary juices in order that they may attract animals to feed on them, and secure transport through their means. An interesting example of the power of attraction is found in the fact that white cherries and yellow strawberries are not nearly so much the prey of birds as the red varieties. To prevent seeds from being crushed in the mouth, and secure their passing unharmed through the intestines of animals, a certain amount of protection is necessary. This is secured to such fruits as the plum and cherry by the hard endocarp. In the strawberry the seeds, which are very minute, are enclosed in the hard pericarps of the true fruits; while in the apple and pear the smoothness and slipperiness of the pips prevents their being easily crushed between the teeth. Edible fruits are especially adapted for distribution by birds, but pigs, bears, monkeys, cats and lizards share in their dispersal. The digestive juices of animals do not seem to injure most seeds, the stones of hawthorn berries and of holly berries having been long observed to germinate better when voided by turkeys. It may be added that all seeds distributed by birds do not pass through the intestines. Birds are said to eject, without swallowing, the seeds of the spindle-tree, and hornbills are in the habit of casting up pellets of seeds.

To recapitulate, we have seen that:—

i. By a fruit is meant the mature ovary of a plant containing the ripened ovules. True fruits result from the development of the ovary alone; spurious or false fruits consist of developed ovaries surrounded by or embedded in other structures. The strawberry, rose-hip, apple and pear are examples of spurious fruits, each formed from a single flower. The fig, pineapple and mulberry are spurious fruits which, since they result from a number of flowers, are called collective fruits.

ii. True fruits may be divided into two classes—dry fruits, possessing a woody or tough pericarp or wall; and succulent fruits, the walls of which are more or less fleshy.

iii. Varieties of dry indehiscent (not opening) fruits, containing but one seed, are found in the strawberry (achene), grass (caryopsis), sunflower (cypsela), hazel (nut). Dry indehiscent fruits, containing more than one seed, occur in the case of the garden nasturtium (schizocarp), and maple (samara).

iv. In dehiscent dry fruits, the pericarp opens at maturity to liberate the seeds. Examples are found in the larkspur (follicle), pea (legume), wallflower (siliqua), horse radish (silicula), and poppy (capsule).

v. Succulent fruits have a more or less fleshy pericarp. They may be indehiscent (*e.g.*, cherry, plum); or dehiscent (*e.g.*, walnut).

vi. The arrangement of the ovules in the ovary is called their placentation. It may be marginal (pea), axile (tulip), parietal (stock), free-central (primrose), superficial (water-lily). The direction assumed by the ovule may be erect (dock), ascending (buttercup), pendulous (rose), suspended (anemone), horizontal (lily).

vii. The agencies by which seeds and fruits are distributed are—(i) the agency of the plant itself, (ii) water, (iii) wind, (iv) animals.

viii. Seeds are distributed, in many instances, through the elasticity of the fruit, which frequently splits to discharge the seeds, as in the case of the geranium and broom. In some fruits (*e.g.*, the squirting cucumber) the exploding force is due to turgescence.

ix. Water is found to be an important agent in the distribution of seeds enclosed in a covering which is at the same time water-tight, and light enough to enable the seeds to float. Floating timber and floating ice aid in the distribution of seeds by water, uprooted trees

being often carried great distances by ocean currents, while icebergs often carry earth on their surface.

x. Seeds not otherwise adapted for flight are often borne long distances by whirlwinds or hurricanes, but seeds distributed by the wind are generally very light (poppy), or have flat or bordered ends (tulip, golden dust), or wings (sycamore, lime), or a pappus (dandelion).

xi. Animals aid in the distribution of plants by the adherence of soil to their coats, and by the discharge of seeds in their excreta. Special appendages of fruits and seeds, fitting them for transport by the agency of animals, are burrs, sticky hairs, or a glutinous surface.

xii. Bright colours, sweet odours, and sugary juices appear to be developed by fruits, to induce animals to feed on them. The digestive juices of animals do not seem to injure seeds.

THE 1894 SCHOLARSHIP EXAMINATION.

BY DR. GEORGE BEACH, M.A.,

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I.—Important Notice.

In consequence of the change in the Training College Year, there will be this year *two* Scholarship Examinations, one commencing on 4th July and the other on 19th December.

There has also been published a Queen's Scholarship Syllabus, so that our candidates will not be obliged to depend merely on Schedule V. of the Code.

This will be forwarded by the Department, on application, gratis and post free.

Considering the uncertainty involved in such subjects as Domestic Economy, a more definite series of directions will be greatly appreciated.

Failure at both (or either) of these Examinations will be reckoned as one failure only.

Candidates cannot be admitted to the Examinations unless application has been made to the Department on their behalf, before the 1st May and 1st October.

II.—A Few Questions in Religious Knowledge.

1. '*I pray unto God to give me His grace, that I may continue in the same unto my life's end.*' State in what part of the Catechism these words occur.

Explain '*the same*,' and illustrate the clause fully from Holy Scripture.

2. Show from Holy Scripture that the Ten Commandments are binding on all Christian people, and quote from the New Testament passages which enforce the duties implied in Commandments IV., VI., and IX.

3. How is the term '*Litany*' explained in the Prayer Book? Show that this explanation applies. Explain carefully all the words in italics in the phrase—

'*By* the *Mystery* of *Thy Holy Incarnation*.'

4. By what names and titles do we address God and Christ in the Versicles and Prayers with which the Litany concludes? Explain the significance of each appeal.

5. What provision for assuring sinners of forgiveness of sins after Baptism does our Church make in Morning and Evening Prayer? On what conditions is this forgiveness extended? Give Scriptural authority for the words used.

6. What are the Latin names of the Canticles used at Morning Prayer?

What account can you give of their authors or origin?

III. Arithmetic.

Of late years, it has been the custom to set 14 questions, the first of which is divided into 4 sections.

Candidates may not answer more than *three* of these sections under 'Question 1,' and may answer *eleven* other sections. There is thus little choice offered. If more than 12 questions are answered, only the 12 coming first on the paper will be marked.

The solutions must be given at such length as to be intelligible to the Examiner, otherwise the answer will be considered as of no value.

Marks are given for portions of questions and for correct methods, even if there be some trifling inaccuracies.

Calculations should be as much mental as possible, if they can be followed by the Examiner, and the results only of long processes may be set down (in order to conduce to neatness and clearness), provided always that the operations are indicated on the 'scrap' half of the paper.

We are told that there should be '**No Writing between the lines.**' It is a matter of prime discretion in Arithmetic when to observe and when to violate this rule. Actually the regulation does not refer to figures.

The three principal points to be sought in Arithmetic are: i. Good Methods, ii. Accuracy, iii. Speed, and these act and re-act upon each other.

i. *Good Methods* can only become conversant by a thorough and familiar acquaintance both with the theory and 'Short Cuts' of Arithmetic. Moreover the methods should be such as a Teacher could impart to his Pupils. Save School-Management, there is no Scholarship Subject where the Teacher Examinee is kept so much in view as in Arithmetic. Arithmetic is a Failing Subject.

A clear knowledge of theory, the possession of scientific definitions, the production of graphic illustrations, and a faculty of lucid and systematic arrangement and explanation are therefore essential.

Many '*Short Cuts*' can be acquired from books; but others must be invented extemporaneously. The problems generally lend themselves to scientific manipulation.

ii. *Accuracy* is obtainable by (*a*) Good Methods, (*b*) Careful Revision, and (*c*) Different ways of working the same problem.

(*a*) *Good Methods* take Short Cuts, and it is obvious that the fewer the figures the less the chance of errors; the simpler the process, the less does intricacy confuse the mechanical operations.

(*b*) *Careful Revision* should follow each executed step, and thus any error be 'nipped in the bud,' and prevented bearing disastrous fruit in subsequent operations.

If a sum be revised only when finished, an early error may be discovered, which has propagated itself, and either much untidiness or much loss of time and space must be the consequence.

(*c*) *Different ways of working the same problem* is revision of results, but not revision of processes.

A point can be accurately determined by the intersection of two converging lines, and a result may be confidently pronounced correct if obtained by two converging methods.

Thus prove a Practice Sum by Multiplication of Money, etc.

iii. *Speed* is the result of Practice and Short Cuts. Here comes in Mental Arithmetic, of which every one should know the ordinary rules, besides being able to multiply and divide by two figures 'in his head.'

In the higher branches the Women, as compared with the Men, are more leniently dealt with, their attention being especially directed to Fractions, Proportion, Profit and Loss, Interest, Discount and Percentages.

Stocks are occasionally set, and we generally find the ladies weak in these. Arithmetic encroaches upon Mensuration as far as to rectangular solids.

Typical Examples.

We cannot profess to set down all the questions given, but must confine ourselves to representative ones.

Theory and Teaching.

1. (*a*) Explain the method of forming the remainder in short division by a composite number, *e.g.*, 4,876 ÷ 105.

Ans. $46\frac{46}{105}$.

At what step in the division of money is the same principle illustrated?

(*b*) Is it rational to divide or multiply one concrete number by another?

Illustrate by these examples :—

(α) Find the number of half-crowns in £3 7s. 6d.
Ans. 27.

(β) Find the price of 5 yds. 2 ft. 6 ins. at 4s. 6d. per yd.
Ans. £1 6s. 3d.

(c) What method do you employ for the '*Division of Decimals*'? How would you explain it to a class? Take as examples :—

(α) 691·73 ÷ ·0013. Ans. 532,100.

(β) 69·173 ÷ 31·3. Ans. 2·21.

(d) What is meant by the ratio of two numbers? Show how the unitary method may be abbreviated by the use of ratios. Illustrate this by this example :—

If 5 cwt. 7 lbs. cost £3 12s. 0d., what is the price of 21 cwt. 1 qr. 14 lbs. (1893, *Men.*) Ans. £15 4s. 0d.

2. (a) Distinguish between *concrete* and *abstract* numbers—between *notation* and *numeration*, and explain (as to a child in Stand. II.) the reason for the process of short division ; *e.g.*, 5,678 ÷ 3. Ans. 1,892⅔.

(b) How would you find the G.C.M. of two numbers which can easily be resolved into simple factors? Explain *why* your answer is the G.C.M.

Take 1,848 and 2,079. Ans. 231.

(c) How would you explain to a class beginning fractions the error in the following? :—$\frac{2}{4} + \frac{3}{7} = \frac{3+2}{4+7} = \frac{5}{11}$.

(d) How would you work on the blackboard and explain to a class (beginning such problems) the following sum? :—

'If 7 men can earn £9 9s. in 6 days, how much will 11 men earn in 4 days at the same rate. (1892, *Men.*)
Ans. £9 18s. 0d.

3. (a) Prove the rule for division when the divisor is a number larger than 12 ; *e.g.*, 36,924 ÷ 79. Ans. 467$\frac{31}{79}$.

(b) How would you explain to children beginning cubic measure that 27 cubic feet make a cubic yard?

(c) Prove to a class beginning multiplication of fractions that '*If the numerator and denominator of a fraction be both divided by the same number, the value of the fraction will not be altered*' ; *e.g.*, $\frac{15}{18} = \frac{5}{6}$. (Illustrate by half-crowns and sixpences.)

(d) Give reasons for the rule of finding the discount of a given sum due a given time hence at a given rate per cent., simple interest.

Find the discount of £299 15s. 0d. due 3 years hence at 3 per cent. per annum, simple interest. (1891, *Men.*)
Ans. £24 15s. 0d.

4. (a) How would you explain *Long Division* to a class of children who have worked sums in Short Division? Take 403 ÷ 19.
Ans. 21$\frac{4}{19}$.

(b) By what method would you enable children to ascertain whether a given number is a prime? *e.g.*, 163. Ans. Prime.

(c) How would you explain to beginners in fractions that '*The value of a fraction is not altered by multiplying its numerator and denominator by the same number*'?

(d) Define '*Proportion.*' Give a simple method for proving that '*The product of the extremes is equal to the product of the means.*' (1893, *Women.*)

5. Say how you would *prove* to a class of children that—

(a) $5 \times 6 = 6 \times 5$.

(b) One-seventh of three = three-sevenths of one.

(c) If A is $\frac{2}{3}$ of B, then B is $\frac{3}{2}$ of A.

(d) '*The product of the extremes is equal to the product of the means*' in Proportion. (1892, *Women.*)

6. Prove the rule—

(a) For Multiplication when the multiplier is a larger number than 12 (*e.g.* 3219 × 629). Ans. 2,024,751.

(b) For Reducing a fraction of any denomination to a fraction of another denomination (*e.g.*, 3s. 7½d. to fraction of 12s. 8¼d.). Why is the answer not money? Ans. $\frac{2}{3}$.

(c) As to a class of beginners, for L.C.M. (*e.g.*, 12, 28, 42). Ans. 84.

(d) For finding Simple Interest of a given sum at a given rate per cent. per annum. Take £275 for 3 years at 7 per cent. per annum. (1891, *Women.*) Ans. £57 15s. 0d.

In several '*Scholarship Guides*' a dozen or more pages are taken up by ancient examples in Numeration, Notation, Addition, Subtraction, Multiplication and Division, both Simple and Compound, and Bills of Parcels.

It was formerly the custom to set questions upon the whole range of P. T. Arithmetic, beginning with the simplest operations and advancing to the end of Syllabus, but no question under any of the heads mentioned above has been given since 1888.

Practice.

7. Value of 15 tons 19 cwt. 3 qrs. 16 lbs. @ £26 5s. 0d. per ton. (*Men*, 1893.) Ans. £419 17s. 2½d.

8. Rent of a farm 179 acres 3 roods 16 poles @ £1 3s. 4d. per acre. (*Women*, 1893.) Ans. £209 16s. 6d.

9. Value of 51 bhls. 1 peck 1 gall. 3 qts. at £1 3s. 9½d. per peck. (*Women*, 1892.) Ans. £244 13s. 9$\frac{3}{4}$d.

10. Cost of a fence 3 furls. 9 pls. 2¾ yds. long at £205 6s. 8d. per mile. (*Men*, 1891.) Ans. £83 1s. 11d.

11. 9,036 articles at £1 19s. 11½d. each. (*Women*, 1888.)
Ans. £18,046 18s. 0d.

12. Price of two fields, measuring respectively 25 acres 3 roods 27 poles, and 85 acres 2 roods 19 poles, at 250 guineas per acre. (*Women*, 1887.) Ans. £29,278 11s. 10½d.

L.C.M. and G.C.M.

13. What is the greatest length of which 18 yds. 1 ft. 3 ins. and 20 yds. 1 ft. 9 ins. are multiples? (*Women*, 1893.)
Ans. 1 yd. 3 ins.

14. Find the L.C.M. of 12, 64, 80, 96, 120, and 160. (*Women*, 1892.) Ans. 960.

15. The G.C.M. of two numbers is 119, their L.C.M. is 11,781 ; one of the numbers is 1,071. Find the other. (*Women*, 1890.)
Ans. 1,309.

16. Two men take steps of 2$\frac{34}{35}$ and 2$\frac{37}{40}$ feet respectively. If they start in step and walk side by side, how far will they have walked before they are in step again, and how many steps will each have taken? (*Men*, 1889.)
Answers. 63 steps, 64 steps, 62 yds. 1⅛ ft.

17. If a rupee be worth 1s. 5¼d. and a dollar 3s. 10d., find the least number of rupees which makes an exact number of dollars. (*Women*, 1889.) Ans. 8.

18. On a rock are three revolving lights. One revolves in 2 mins. 12 secs., another in 3 mins. 7 secs., the third in 3 mins. 24 secs. I saw them all bright at midnight. When will they next be so? (*Men*, 1888.) Ans. 37 mins. 24 secs. after 12 a.m.

Vulgar Fractions.

19. Determine the order of magnitude of the fractions $\frac{104}{165}$, $\frac{133}{334}$, $\frac{154}{210}$. (*Men*, 1893.) Ans. They are in ascending order.

20. The sum of two numbers is 5$\frac{2}{3}$, the greater is 2$\frac{7}{8}$. What is the smaller? (*Women*, 1892.) Ans. 2$\frac{23}{24}$.

21. $\frac{25}{45}$ of 8$\frac{1}{3}$ of 12$\frac{3}{4}$ + $\frac{35}{51}$ of 1$\frac{17}{21}$ − $\frac{80}{81}$ of 1$\frac{33}{80}$. (*Women*, 1890.)
Ans. 33$\frac{1}{3}\frac{15}{25}$.

22. Divide 2$\frac{1}{2}$ − $\frac{3}{5}$ of 1$\frac{5}{8}$ by $\frac{1}{5}$ of 3$\frac{1}{3}$ + $\frac{7}{8}$. Reduce $\frac{4}{11}\frac{72}{24}$ to its lowest terms. (*Men*, 1892.) Answers $\frac{3}{4}$; $\frac{7}{8}$.

23. Express $\frac{5}{81}\frac{15}{81}$, $\frac{1837}{2630}$ in their lowest terms, and find the product of 11$\frac{3}{5}$, 4$\frac{5}{13}$, 1$\frac{1}{13}$ in its simplest form. (*Women*, 1888.)
Answers $\frac{5}{9}$, $\frac{9}{13}$, 50$\frac{1}{2}$.

24. Simplify 7$\frac{5}{6}$ + $\frac{3}{4}$ of $\frac{7}{12}$ + $\frac{5}{8}$ of 23$\frac{1}{3}$. (*Women*, 1887.)
Ans. 22$\frac{83}{144}$.

25. Simplify $\frac{(1\frac{7}{8} - 3\frac{1}{4}) \text{ of } (\frac{4}{13} - \frac{3}{16})}{\frac{5}{8} + \frac{1}{2} - \frac{13}{11}}$. (*Women*, 1892.)
Ans. $-10\frac{685}{1664}$.

26. Simplify $\frac{1\frac{13}{87} + \frac{91}{117}}{\frac{5}{6} + \frac{21}{26}} - \frac{1\frac{31}{41}}{1\frac{31}{41}}$. (*Men*, 1891.) Ans. 1.

27. Simplify $\frac{\frac{63}{82} - \frac{63}{65}}{\frac{83}{82} - \frac{83}{63}} \times 16\frac{1}{4}\frac{1}{3}$. (*Men*, 1890.) Ans. 25.

28. Simplify $\frac{6\frac{3}{5} - 2\frac{1}{5}}{3\frac{1}{2} + 1\frac{1}{4}} \times \frac{\frac{1}{2} - \frac{1}{3}}{\frac{1}{2} + \frac{1}{6}}$. (*Women*, 1888.) Ans. $\frac{134}{165}$.

29. Reduce $(4\frac{3}{5} + 9\frac{1}{15} - 10\frac{1}{2} - \frac{53}{117})$ of 5s. 7½d. to the fraction of $\frac{\frac{5}{6} - \frac{3}{4}}{\frac{5}{8} - \frac{5}{12}}$ of 9s. 4d. (*Men*, 1893.) Ans. $\frac{3}{5}$.

30. Reduce $\frac{3}{4}$ of £7 5s. 3d. + $\frac{4}{13}$ of £17 15s. 10½d. + $\frac{5}{17}$ of £1 6s. 11d. to the fraction of £26 19s. 0d. (*Women*, 1893.)
Ans. $\frac{1}{2}$.

31. Reduce $\frac{22}{33}$ of $\frac{9}{25}$ of £81 13s. 4d. + $\frac{35}{41}$ of $\frac{22}{65}$ of 8s. 10½d. — $\frac{1}{17}$ of 9s. 11d. to the fraction of £6 10s. (*Men*, 1891.) Ans. $\frac{3}{5}$.

32. Reduce $\frac{22}{35} \times \frac{10}{66} \times$ £2 12s. 1d. + $\frac{46}{4} \times \frac{94}{115} \times$ £5 13s. 9d. to the fraction of £11 6s. 11d. (*Women*, 1891.) Ans. $\frac{2}{3}$.

Mixed Decimals and Vulgars.

33. $6{\cdot}3\dot{6} \times {\cdot}57142\dot{8}$. (*Men*, 1893.) Ans. $3{\cdot}6\dot{3}$.

34. $2{\cdot}74\dot{9} \times {\cdot}25\dot{4} \times 190476\dot{0} \times$ £2½. (*Women*, 1892.) Ans. 6s. 8d.

35. Find the difference between 11·5 of $0.\dot{6}$ of £3 7s. 9d. and $2\frac{2}{3}$ of £27 8s. 6½d. (*Women*, 1892.) Ans. £45 6s. 9½d.

36. Express ·481 and ·72 as vulgar fractions in their lowest terms, and their difference as a circulating decimal. (*Men*, 1892.) Ans. $\frac{13}{27}$, $\frac{7}{9}$, $\cdot 2\dot{4}0\dot{7}$.

37. ·421442 ÷ ·002103, and $5{\cdot}5\dot{4} \div 3{\cdot}3\dot{8}$. (*Men*, 1891.) Answers $200{\cdot}4$; $1{\cdot}\dot{6}\dot{3}$.

38. Express $\frac{11}{17}$ as a decimal, and find the value of £1·285 — 5·11s. + 6·92 farthings. (*Men*, 1890.) Answers $\cdot 2\dot{9}7\dot{0}$; £1 0s. 8¾d.

39. Reduce $\frac{8}{11}$ of £22 8s. 3d. + $\frac{8}{13}$ of £13 6s. 6d. — $\frac{8}{17}$ of £21½ to the decimal of £25·1125. (*Women*, 1890.) Ans. $\cdot\dot{3}$.

40. Simplify $\frac{\cdot 00153 \times 11{\cdot}05}{2{\cdot}89} + \frac{1{\cdot}4}{1{\cdot}1\dot{3}}$. (*Women*, 1889.) Ans. 1·24335.

Decimals.

41. Simplify $3{\cdot}52 \div {\cdot}005 \times 1{\cdot}03 \div {\cdot}044$. Find the value of ·0109375 miles. (*Women*, 1893.) Answers 16,480; 19 yds. 9 ins.

42. Divide ·02156 by ·0022. (*Men*, 1892.) Ans. 9·8.

43. Divide ·4214412 by ·002103 and $5{\cdot}5\dot{4}$ by $3{\cdot}3\dot{8}$. (*Men*, 1891.) Ans. $200{\cdot}4$; $1{\cdot}\dot{6}\dot{3}$.

44. Find the value of 6·9375 cwts. + ·35 of 2·5 qrs. + ·0421875 tons. (*Women*, 1891.) Ans. 8 cwts.

45. Subtract 1·003755 quarts from ·04325 of a bhl, and give the answer as the decimal of a pint. (*Women*, 1890.) Ans. ·76049.

46. A man runs 2·625 times round a course 293·3 yards long. What decimal fraction of 1·53125 miles does he run? (*Men*, 1889.) Ans. $\cdot\dot{2}85714\dot{2}$.

47. Take ·0625 of £28 6s. 0d. from $\frac{17}{16}$ of £20 0s. 6d. and find by what decimal the result must be multiplied to produce £2 17s. 1½d. (*Men*, 1889.) Ans. ·16.

Proportion.

48. An employer pays each of his workmen 27s. per week when they work 9 hours a day; what should he pay them, when they work only 8 hours a day, if in that case 12 men do as much as 13 formerly? (*Men*, 1893.) Ans. 26s. 0d.

49. If the carriage of 3 tons 15 cwt. for a distance of 200 miles costs £11 13s. 4d., how much should be charged for 7½ cwt. for 125 miles? (*Women*, 1893.) Ans. 14s. 7d.

50. If 56 acres 2 roods 21 poles cost £3,899 2s. 0d., how much will 17 acres 3 roods 33 poles cost? (*Men*, 1892.) Ans. £1,236 6s. 0d.

51. How many days will it take 75 men to excavate a canal 4 miles long, 10½ feet wide, and 9 feet deep; 37½ days having being required by 105 men to dig a canal 1,400 yards long, 24 feet wide, and 5½ feet deep? (*Men*, 1892.) Ans. 189 days.

52. If 3 cwt. 1 qr. 15 lbs. cost £10 17s. 6d., what will 7 cwt. 3 qrs. 12 lbs. cost? (*Women*, 1892.) Ans. £25 5s. $0\frac{60}{179}$d.

52 (*a*). If 18 pumps can raise 2,140 tons of water in 10 days, working 7 hours a day, in how many days will 16 pumps raise 1,634 tons working 9 hours a day? (*Men*, 1891.) Ans. $6\frac{13}{28}$ days.

53. A partner in the business is entitled to $\frac{1}{8}$ of the profits. What were the average annual profits when his share for 2½ years was £1,010 17s. 9d.? (*Women*, 1891.) Ans. £974 15s. 8½d.

54. Find a fourth proportional to ·0247, $\cdot\dot{3}8$ and 12·87. (*Women*, 1891.) Ans. 200.

55. First, second, and third class fares are 2½d., 1½d., and 1d. per mile respectively. There are 5 first-class passengers to every 3 second, and to every 47 third. What sum did each class of passengers contribute to a total receipt of £53,974 16s. 0d. (*Men*, 1893.) Ans. £11,244 15s. 0d.; £4,293 9s. 0d.; £38,436 12s. 0d.

56. A man left £36,288 to be divided between his two sons in proportion to their ages, which were 19 and 23 years. What sum did each receive; and what difference would it have made to each, if the father had lived 3 years longer? (*Women*, 1891.) Ans. £16,416; £19,872; £216; £216.

57. If the wages of 37 men for 27 days are £233 2s. 0d., what will be the wages of 42 men for 45 days? (*Women*, 1891.) Ans. £441.

58. If the Income Tax were 3½ per cent. on a man's income instead of 8d. in the £, what difference would it make to a man whose annual income is £3,125. (*Men*, 1886.) Ans. £5 4s. 2d. less.

59. If 7 men earn in a day as much as 8 women, and 1 woman as much as 2 boys, and if 7 men, 6 women, and 12 boys working together for 10 days earn £21, what will be the earnings of 8 men and 8 women working together for 6 days? (*Men*, 1886.) Ans. £11 8s. 0d.

Partnership and Mixtures, etc.

60. A, B, C invested respectively £9,410, £3,674, and £5,216 in a business. The net profits were £1,448 15s. 0d. How should they be divided? (*Women*, 1893.) Ans. £744 19s. 2d.; £290 17s. 2d.; £412 18s. 8d.

61. Two men own adjoining farms of 360 and 540 acres respectively. They unite the farms and take a partner who pays them £2,000 on the understanding that a third share of the land shall in future belong to each. How is the £2,000 to be divided between the original owners? (*Men*, 1890.) Ans. £400; £1,600.

62. Three men hire a pasture for £42 12s. 0d. One puts in 10 oxen for 9 months, another 12 oxen for 8 months, the third 14 oxen for 7 months. What part of the rent should each pay? (*Men*, 1887.) Ans. £13 10s. 0d.; £14 8s. 0d.; £14 14s. 0d.

63. £52 18s. 0d. is made up of half-sovereigns, half-crowns, and sixpences in the proportion of 3 : 5 : 7. How many coins are there? (*Women*, 1887.) Ans. 345 coins.

64. A wine glass is filled with a mixture of spirit and water in the ratio of 1 of spirit to 4 of water. Another glass of same size is filled in the ratio of 2 of spirit to 5 of water. Find the ratio of spirit to water, when the contents of the two glasses are mixed in a tumbler. (*Men*, 1886.) Ans. As 13 : 40.

65. A sum of £3,070 3s. 3d. has to be divided amongst A, B, and C, so that A may have $\frac{1}{3}$ of $\frac{4}{5}$ of B's share, B $\frac{4}{5}$ of A's and C's together. Find their respective shares. (*Men*, 1883.) Ans. £202 3s. $0\frac{4}{11}$d.; £1,364 10s. 4d.; £1,503 9s. $10\frac{8}{11}$d.

'A, B, C' Problems.

66. A pipe A can fill a cistern in 30⅓ mins., a pipe B in 38½ mins., a pipe C can empty it in 17⅞ mins. If it be empty and A, B, C are opened together, in what time will the cistern be filled? (*Women*, 1893.) Ans. hrs. 5–33–40.

67. A, B, C fill up a pit in 2½ hours, throwing in respectively 6, 8, 9 shovelfuls per minute. In what time would each have done it by himself? (*Men*, 1892.) Ans. 9 hrs. 35 mins.; 7 hrs. 11½ mins.; 6 hrs. $23\frac{1}{11}$ mins.

68. A and B can reap a field in 10 days; A and C in 12 days, B and C in 15 days. They all work together for 4 days, when A leaves. Then B and C work together for 6 days more, when B leaves. In how many days will C finish the work? (*Women*, 1892.) Ans. 4 days.

69. A can do $\frac{1}{3}$ of a piece of work in 2 hours, B can do $\frac{2}{5}$ of the remainder in half-an-hour, C can then finish it in 2 hours. How long would A, B, C together take to do the whole? (*Women*, 1891.) Ans. 1½ hours.

69 (*a*). If 12 sheep *or* 18 lambs can eat 45 bushels of turnips in 9 days, how long will it take 20 sheep and 15 lambs to eat the same number of bushels? (*Women*, 1890.) Ans. $3\frac{9}{11}$ days.

70. A and B together can do a piece of work in 30 days. B by himself can perform the same in 70 days. In what time could A finish it by himself, and how much more of the work does A than B? (*Men*, 1875.) Ans. 52½ days; ⅓.

Averages.

71. A person has equal sums of money invested in three undertakings, which yield respectively 3 per cent., 4 per cent., and 5 per cent. His total income being £240, what is his capital. (*Men*, 1892.) Ans. £6,000.

72. Two steamers leave a place at the same time for the same port distant 1,260 miles. The faster steamer averages 11½ miles an hour, and arrives at the port 28 hours before the other. What did the slower vessel average per hour? (*Men*, 1891.) Ans. 9 miles.

73. The travelling expenses of 9 tourists for 5 weeks amounted to £102 7s. 6d. A second party of 7 made the same tour in 6 weeks, their average weekly expenditure per man being $\frac{5}{8}$ that of the first party. What were the total expenses of the second party? (*Women*, 1889.) Ans. £79 12s. 6d.

74. A farmer pays a rent of £1 5s. 0d. per acre for 150 acres, of £1 12s. 6d. per acre for 120 acres, and £2 1s. 8d. per acre for 90 acres. What is his average rent per acre? (*Women*, 1889.) Ans. £1 11s. 8d.

75. The weights of four rowers in a boat are respectively 10 st. 6 lbs., 10 st. 9 lbs., 11 st. 1 lb., and 11 st. 3 lbs. The average weight of the whole crew, including the coxswain, is 10 st. Find the weight of the coxswain. (*Women*, 1887.) Ans. 6 st. 9 lbs.

76. In a certain town 9 schoolmasters receive annual salaries amounting to £1,109 2s. 0d.; 17 schoolmistresses, and 19 pupil-teachers, receive salaries amounting to £1,602 0s. 8d. The average salary of a pupil-teacher being one-fifth that of a schoolmistress, compare the average salary of the schoolmaster and the pupil-teacher. (*Men*, 1879.) Ans. As 8 : 1.

Percentages.

77. If the duty on an article be reduced 40 per cent. on its present amount, by how much per cent. must the consumption be increased, so that (*a*) the revenue shall not suffer, (*b*) that it may gain 10 per cent.? (*Men*, 1893.) Ans. 66⅔; 83⅓.

78. A man makes a profit of 2½ per cent. by selling an article for £1 1s. 4½d., how much per cent. would he make by selling it for £1 1s. 3d.? (*Men*, 1893.) Ans. 2 per cent.

79. The gross rental of an estate was £1,699 1s. 3d., but the owner returned 24 per cent. of it to the tenants, then spent £66 14s. 1d. on repairs, and the agent received 7 per cent. of the remainder. How much was left for the owner? (*Men*, 1893.) Ans. £1,194 13s. 3d.

80. A man embarks his whole capital in four successive ventures. In each of the first two he gained 75 per cent., in each of the last two he lost 33⅓ per cent. Find the ratio of his final to his original capital. (*Women*, 1893.) Ans. As 49 : 36.

81. Knives are bought at 11 for 10s., and sold at 10 for 11s. What is the gain per cent.? (*Men*, 1892.) Ans. 21 per cent.

81 (*a*). If a man receives on a fourth of his capital 3 per cent., on two-thirds 5 per cent., and on the remainder 11 per cent., what percentage does he receive on the whole? (*Women*, 1891.) Ans. 5 per cent.

82. The Income Tax was reduced from 7½d. to 6d. in the £, but a man's gross receipts were at the same time reduced by 3⅓ per cent. Find by what percentage his net income is altered. (*Men*, 1891.) Ans. 2½ per cent.

83. A general having lost $\frac{2}{13}$ of his men in battle, and 7 per cent. of the remainder by sickness, had 18,414 left. How many had he at first? (*Men*, 1891.) Ans. 23,400 men.

84. A merchant bought 2,000 oranges for £1 6s. 8d. The cost of the packing was 10 per cent. additional, and the cost of carriage was a shilling more than 162·5 times the original cost of one orange. Find the profit on 100 oranges sold at 5 for 2d. (*Women*, 1890.) Ans. 1s. 8½d.

85. At an examination, in which full marks were 1,000, A got 20 per cent. more than B, B 10 per cent. more than C, and C 20 per cent. less than D. If A got 660 marks, what percentage of full marks did D secure? (*Men*, 1889.) Ans. 62½ per cent.

86. A merchant gains 20 per cent. on ⅓ of his capital, 40 per cent. on ⅓, and loses 24 per cent. on the remainder. What is his gain or loss per cent. on the whole capital? (*Women*, 1889.) Ans. 8⅔ per cent. gain.

Simple Interest.

87. Find the rate per cent. per annum at which £314 12s. 6d. will amount to £346 1s. 9d. in 2⅔ years at Simple Interest. (*Women*, 1893.) Ans. 3¾ per cent.

88. In what time will £385 4s. 2d. amount to £471 17s. 7½d. at 5 per cent. per annum Simple Interest? (*Men*, 1892.) Ans. 4½ years.

89. What is the Principal which will yield £14 2s. 6d. in 219 days at 4 per cent.? (*Women*, 1892.) Ans. £588 10s. 10d.

90. In what time will £1,005 6s. 8d. amount to £1,156 2s. 8d. at 4 per cent. per annum, Simple Interest? (*Men*, 1890.) Ans. 3¾ years.

91. In what time will £10,055 amount to £11,186 3s. 9d. at 2½ per cent. per annum, Simple Interest? (*Women*, 1890.) Ans. 4½ years.

92. At what rate per cent. per annum, Simple Interest, will £1,450 amount to £1,621 13s. 9d. in 5¾ years? (*Men*, 1889.) Ans. $2\frac{78}{115}$ per cent.

93. In what time will £488 3s. 4d. amount to £506 9s. 5½d. at 3 per cent. per annum, Simple Interest? (*Women*, 1889.) Ans. 1¼ years.

Compound Interest.

94. What is the difference between the Simple and Compound Interest on £1,350 for 3 years at 5 per cent.? (*Women*, 1892.) Ans. £10 5s. 10½d.

95. Find the exact difference between the Simple and Compound Interest on £6,072 for 3 years at 3½ per cent. (*Men*, 1891.) Ans. £22 11s. 5·98488d.

96. Find the exact Compound Interest on £3,456 for 3 years at 4 per cent. per annum. (*Women*, 1891.) Ans. £431 10s. 7·19616d.

97. What will £6,510 8s. 4d. amount to in a year and a half if put out at Compound Interest at 8 per cent. per annum, the interest being added every half-year? (*Men*, 1890.) Ans. £7,323 6s. 8d.

98. Find the exact difference between the Simple and Compound Interest on £2,450 for 3 years at 3 per cent. per annum. (*Men*, 1889.) Ans. £6 13s. 7·476d.

99. What would be the difference between the Simple and Compound Interest of £9,902 13s. 4d. for 2½ years at 3½ per cent.? (*Women*, 1879.) Ans. £24 9s. 5·71722d.

Discount and Present Worth.

100. Find the difference between the Simple Interest and the Discount on £1,501 13s. 4d. due 2½ years hence at 2½ per cent. (*Men*, 1893.) Ans. £88 6s. 8d.

101. If the present worth of £232 17s. 6d. due in a year at 3½ per cent. be invested in a 3½ per cent. stock at 112½, what income, neglecting brokerage, will be derived? (*Women*, 1893.) Ans. £7.

102. The present worth of £1,321 15s. 0d. due in 2½ years is £1,244. Find the rate per cent. per annum, Simple Interest. (*Women*, 1891.) Ans. 2½.

103. The true discount on a sum due 18 months hence at 4 per cent. per annum is £22 0s. 3d. What is the sum? (*Women*, 1890.) Ans. £388 17s. 9d.

104. Find the present value of £1,363 due 5 years hence at 3½ per cent. per annum Simple Interest. (*Men*, 1882.) Ans. £1,160.

105. A clerk is directed to calculate the discount on £1,620 due 3 months hence at 5 per cent. Find the error that would be produced were he to calculate interest instead of discount. (*Men*, 1878.) Ans. 5s. 0d.

Stocks.

106. A person invests half his capital in 3 per cent. debentures at 101½, and the other half in 4 per cent. debentures at 135. His total income from both sources is £202 15s. 0d. How much did he invest? (*Men*, 1893.) Ans. £6,851 5s. 0d.

107. A man buys railway debenture shares, paying 4½ per cent., and he buys at such a price as to get 3½ per cent. on his money. At what price does he buy? What sum must be invested in the 2¾ per cent. consols at 96¼ in order to derive an income of £166 13s. 4d.? (Neglect brokerage.) (*Men*, 1892.) Ans. £135; £5,833 6s. 8d.

108. If a person sells for £18 each, 50 ten pound shares which pay 8 per cent., and then invests the proceeds in £5 shares at £3 10s. each, find what difference is made in his income, the second company paying 3½ per cent. (*Women*, 1892.) Ans. £5.

109. A man invests part of £2,445 in a 5 per cent. stock at £120 and the rest in another 5 per cent. stock at £125. His income from the two investments is £100. Neglecting brokerage, what did he invest in each stock? (*Men*, 1891.)
Ans. £1,125 ; £1,320.

110. What sum must be invested in 4 per cents. at 113 to produce an income of £240 6s. 8d., neglecting brokerage? (*Women*, 1891.) Ans. £6,789 8s. 4d.

111. A trustee has £7,890 to invest. With £4,301 he buys stock at 93½, with the rest he purchases stock at 97. Neglecting brokerage, how much stock does he hold? (*Men*, 1890.)
Ans. £8,300.

112. A man has £3,000 of a 4 per cent. stock. He sells out at 120 and then invests £1,900 in a 2¾ per cent. stock at 95. What rate of interest does he get for the remainder if his income is on the whole £14 less? (*Women*, 1890.) Ans. 3 per cent.

113. What is the price of 3 per cent. stock when a sum of £4,353 4s. 7d. invested will, neglecting brokerage, produce an income of £132 5s. 0d. (*Men*, 1889.) Ans. £98¾.

114. If a man invests £5,985 in a 3 per cent. stock at 99¾, what income will he receive? If he sell the stock at 100½ what will he get for it? (*Women*, 1889.)
Ans. £180 ; £6,007 10s. 0d.

Square Root, etc.

115. Extract the square root of $154751\frac{77}{169}$. (*Men*, 1892.)
Ans. $393\frac{5}{13}$.

116. A square field contains 21 acres 3 roods 1 pole. How long will it take a man to run round the boundary at the rate of 7½ miles per hour? (*Men*, 1890.) Ans. 5 mins. 54 secs.

117. Subtract the number whose square root is ·01 from the number whose square is ·01871424. (*Men*, 1889.) Ans. ·1367.

118. Find in inches to three places of decimals the side of a square which contains 41·9 sq. ft. (*Men*, 1884.)
Ans. 77·676 ins.

119. Find the square root of 89820·09. Find also the cube root of $16\frac{503}{729}$. (*Men*, 1883.) Answers 229·7 ; $2\frac{5}{9}$.

120. Find the edge and largest diameter of a cubical tank which contains 134,217,728 cub. ins. (*Men*, 1880.)
Answers 512 ins. ; 886·366464 ins.

Mensurational Arithmetic.

121. Find the side of a square equal in area to a rectangle 24·7 ft. by 7138·3 ft. (*Men*, 1893.) Ans. 419·9 ft.

122. How many allotments of 3 acres 2 roods 20 poles each may be taken out of a piece of land 14½ miles long, and 7 miles wide? (*Women*, 1890.) Ans. 17,920.

123. A can walk round a rectangular field, whose sides are 411·6 yds. and 548·8 yds., in the same time that B takes to walk from one corner to the opposite corner and back. Find the ratio of their rates of walking. (*Men*, 1886.) Ans, 7 : 5.

124. Two cubical tanks contain together 6,133,248 cub. ft., and the edge of one is twice as long as the edge of the other. Find the edge of each. (*Men*, 1885.) Answers 88 ; 176.

125. Find the number of yards of paper 2 feet wide required for a room 35 ft. long, 25 ft. wide, and 10 ft. high, allowing for a door 7 ft. high and 6 ft. wide, two windows each 6 ft. high and 4 ft. wide, and a fireplace covering 18 square ft. (*Men*, 1884.)
Ans. 182 yds.

126. Find the breadth of a tank 70 ft. long, and 3 ft. deep, which contains 36,288 gallons. N.B.—A gallon = 277·274 cub. ins. (*Men*, 1884.) Ans. 27·7274 ft.

Miscellaneous Problems.

127. A bill of £41 2s. 3d. was paid with an equal number of pounds, shillings, and pence. How many were there of each? (*Women*, 1893. *Men*, 1891.) Ans. 39.

128. The area of a county is 304,629 acres, and the population 207,129. Find to the nearest integer the number of persons per square mile. (*Men*, 1892.) Ans. 435.

129. If 68 oranges be worth 51 buns, and 28 buns be worth 10½ lbs. of sugar, what is the value of 64 oranges when sugar is 2½d. per lb.? (*Men*, 1891.) Ans. 3s. 9d.

130. Two pint measures are filled with milk-and-water. In one the ratio of milk is 6 : 1, in the other 7 : 1. The contents are emptied into a quart measure. Find the ratio of milk to water in it. (*Men*, 1891.) Ans. 97 : 15.

131. How many payments of 12s. 9¾d. amount to £30 2s. 2¼d., and how many plots, each containing 3 roods 20 poles 20 square yards, are there in 41 acres 1 rood 11 poles 2¼ square yards? (*Men*, 1890.) Answers 47 : 47.

132. If 8 lbs. of coffee cost as much as 5 lbs. of tea, and 3 lbs. of tea as much as 32 lbs. of sugar, what is the price of each, when 1 lb. of coffee, 1 lb. of tea, and 1 lb. of sugar together cost 3s. 5¼d.? (*Women*, 1890.) Ans. 1s. 3d. ; 2s. 0d. ; 2¼d. per lb.

133. In a book on Arithmetic an example was printed thus :—If 11 acres — roods 8 poles be worth £2,250, what will 44 acres 3 roods 1 pole cost? The answer was £8,718 15s. 0d. What was the omitted number of roods? (*Men*, 1889.) Ans. 2.

134. A warehouse consisted of 5 floors. The rent of each floor is ·9 times that of the floor below, the rent of the middle floor is £33 15s. 0d. Find the ratio of the rents of the highest and lowest floors, also rent of lowest floor. (*Men*, 1889.)
Answers As 6,561 : 10,000 ; £41 13s. 4d.

135. The total area of 3 estates is 3,536 acres. If the area of the two smaller estates be respectively ⅝ and ⅞ that of the largest, find the acreage of each. (*Men*, 1889.)
Answers Acres 1,560 ; 1040 ; 936.

136. How far may I travel in a coach which goes at the rate of 8 miles per hour, starting at 10 a.m., in order to return on foot to the starting-place, at the rate of 3½ miles per hour, by 32 minutes past 2 p.m.? (*Women*, 1893.) Ans. 10⅞ miles.

137. A man who walks 4½ miles an hour gives a start of 15 minutes to another man, who walks 3½ miles per hour. In what time will the first overtake the second? (*Women*, 1889.)
Ans. 1 hour 10 minutes after second man starts.

138. A man buys a flock of 117 sheep for £248 12s. 6d.; he loses 4, and finds 24 others so sickly, that he must sell them at once for 10s. each less than he gave. At what price per head must he sell the rest to gain £24 by the whole transaction? (*Men*, 1893.)
Ans. £2 12s. 6d.

139. A tradesman bought 451 articles at £3 15s. 7d. each, paid £3 13s. 4d. for the carriage, and sold them at £4 7s. 7½d. each. How much did he gain? (*Women*, 1892.)
Ans. £267 17s. 5½d.

140. The cost price of an article is £2 12s. 6d. per ton; the selling price is £2 18s. 9d. per ton. How many tons should be sold to gain £9 5s. 11¼d.? (*Women*, 1891.) Ans. 29¾ tons.

IV. *See Certificate Article for a few observations upon Latitude and Longitude.*

SELECTED GOVERNMENT QUESTIONS.

First Week.

1. Name the different classes of conjunctions, and give an example of each.

2. Write in Large-hand the word '*Sovereignty.*'
Write in Small-hand '*Discretion of speech is more than eloquence.*'

3. Draw an outline map, with lines of latitude and longitude, of North America, south of New Westminster and Labrador, marking the chief rivers and watersheds.

4. What parts of Great Britain are distinguished from the rest (*a*) as the flattest, (*b*) as the most elevated, (*c*) as the most beautiful, (*d*) as the richest in minerals, and (*e*) as the most populous? Give details.

5. State shortly the circumstances under which the following places were incorporated into our empire :—Jamaica, Cape Colony, Bombay, Gibraltar, Hong Kong.

6. Trace briefly the decline of the Feudal System.

7. Some school subjects are taught because they are useful as information, or in practical life; and others because they furnish good mental exercise. Name some departments of school work in each of these classes, and say which of them you think of most importance.

8. When and how is 'learning by heart' most useful in a school? Give reasons for and against committing to memory—(*a*) Definitions of words; (*b*) rules of grammar; (*c*) dates; (*d*) selections of poetry; and (*e*) arithmetical tables.

9. Sing the following, having the key-note and chord previously given :—

d	:r.m	| f	:m	| s	:d'	| ta	: —
l	:l.t	| d'	:s	| s	:t,	| d	: —
l	:d'	| t	:se	| l	:f	| m	: —
m	:ba	| se	:l	| d'	:t	| l	: —

10. Find the exact difference between the simple and compound interest on £6,072 for three years at 3½ per cent. per annum.
Ans. £22 11s. 5·98488d.

11. A fruiterer has 889 Spanish and 1,397 Maltese oranges; he put them into boxes, keeping the two kinds of oranges separate, and placing the same number in each box. If the number in each box is the greatest possible, find it. Ans. 127.

12. (*Men only.*) Write out Euclid I., 43.
ABC is a triangle right-angled at B. From P the middle point of BC, PQ is drawn perpendicular to AC. Show that the difference of the squares on AQ, QC is equal to the square on AB.

(*Women only.*) What kind of water is best (*a*) for drinking, (*b*) for cooking, (*c*) for washing? How would you make hard water suitable for washing clothes, and what is the chemical process involved?

13. (*Men only.*) $\sqrt{x^2+16x}+7=3x-5$.
Ans. $x=9$ or 2.

(*Women only.*) What are the chief objects for which animal food is cooked?

14. (*Men only.*) Two digits which form a number change places on the addition of 9, and the sum of these two numbers is 33. Find the numbers. Answers. 12 and 21.

(*Women only.*) State briefly the cost, the time required, and the method of cooking three of the following :—A mackerel, a poached egg, a potato pie, a rice pudding, a mutton chop, a rasher of bacon.

15. (*Men only.*) The sides of a five-sided rectilineal figure ABCDE taken in order AB, BC etc. are 18, 24, 30, 24, 18 ft. respectively, and the angles ABC and AED are 90° each. Find the area in feet to two places of decimals. Ans. 821·71 sq. ft.

(*Women only.*) Describe fully the different stages of instruction by which a child would advance from her first lesson in knitting, to making a stocking for a full-grown man.

16. Translate into English—

La tempête dura toute la *nuit;* la jeune fille *la* passa sans abri dans ce lieu désert, *exposée* aux torrents de la pluie, qui ne cessa *que* vers la matin. Lorsque l'aube parut, elle se traîna jusqu'au chemin, extenuée de froid et de faim, *pour* continuer sa route. Heureusement un paysan qui passait *eut* pitié d'elle et lui *offrit* une place sur son chariot. *Vers* les huit heures du matin, elle arriva dans un grand village. Le paysan, qui ne *devait* pas s'y arrêter, la déposa au milieu de la rue et continua sa route.

17. In the above passage parse the italicised words.

Second Week.

1. Write a short essay on one of these topics:—

(*a*) A ship on fire.
(*b*) Closer union with our colonies.
(*c*) A walk round a garden.

2. In what different ways may the Infinitive Mood be used? Give examples.

3. Say what you know about each of the undermentioned places: *Aden, The Campagna, Granada, The Deccan, The Fens, The Black Country, The Peak, Londonderry, The Trossachs, Coventry, Plymouth,* and *Bristol.*

4. Describe physical and political geography. Explain the terms *degree of latitude, longitude, Tropic of Cancer, watershed.* What changes have been recently determined upon by the leading astronomers in the estimation of longitude and of the time of day?

5. What do you know of the duel between the Shannon and Chesapeake?

6. Say who was reigning in England at the beginning of each of the ten centuries, from the tenth to the nineteenth inclusive, and give in each case the date of accession and death.

7. What is meant by style and expression in reading; and how can they best be taught?

8. Explain, as to a class of scholars, the rule for 'cancelling' in either fractions or proportion; and give some examples.

9. Sing the following, having the keynote and chord previously given :—

l	:d'	| t	:l	| se	:l	| m	: —
f	:m	| r	:d	| r	:m	| l	: —
l	:d'	| t	:se	| l	:f	| m	: —
m	:ba	| se	:l	| d'	:t	| l	: —

10. A man invests part of £2,445 in a 5 per cent. stock at 120, and the rest in another 5 per cent. stock at £125; his income from the two investments is £100 per annum. What sum did he invest in each stock? (*Neglect brokerage.*)
Answers £1,320 and £1,125.

11. If 18 pumps can raise 2,150 tons of water in 10 days, working 7 hours a day, in how many days will 16 pumps raise 1,634 tons, working 9 hours a day?
How many hours of work is your answer equal to?
Ans. $6\frac{13}{20}$ days, *or* $59\frac{17}{20}$ hrs.

12. (*Men only.*) Write out Euclid II. 12.
What is the size of the angle of a regular pentagon, heptagon, and nonagon?

(*Women only.*) What would you consider a suitable stock of house-linen for a young teacher (unmarried) living in a small house of her own? State the material and average cost of each article.

13. (*Men only.*) Solve $(x^2+y^2)(a-b)=a^3-b^3$; $(x^2-y^2)(a+b)=a^3+b^3$. Ans. $x=\pm\sqrt{a^2+b^2}$; $y=\pm\sqrt{ab}$.

(*Women only.*) Describe simply and plainly in a letter to a Pupil Teacher, *either* :—

(*a*) The advantages of the system carried out in the Post Office Savings Bank; *or*

(*b*) The special benefit to be derived from any other secure mode of investment for persons of small and limited means.

14. (*Men only.*) A crew which can pull at the rate of 12 miles an hour down the stream, finds that it takes twice as long to come up. At what rate does the stream flow? Ans. 3 miles an hour.

(*Women only.*) Describe the special properties of milk, and its adaptation to the very young.

15. (*Men only.*) Find the diagonal of a square that shall be equal in area to a rectangle of which two adjacent sides are 30 and 20.
Ans. 34·64.

(*Women only.*) Cut out in paper, and make up, by tacking, a woman's gored flannel petticoat (half-size).

16. Draw up a genealogical table showing the nations descended from Abraham.

17. Describe our Lord's *second* temptation by the Pharisees, Sadducees, and Herodians.

Third Week.

1. Analyse fully the following lines, and parse the words in italics :—

> There at the foot of *yonder* nodding beech,
> *That* wreathes its old fantastic roots so *high*,
> His listless *length* at noontide *would he stretch*,
> And *pore* upon the brook that babbles *by*.

2. Write the following from Dictation :—

Nor was he | less solicitous | for the defence, | than he had shown himself | for the regulation, | of his kingdom. | He nourished | with particular care | the new naval strength, | which he had established ; | he built forts and castles | in the most important ports ; | he established beacons | to spread an alarm | on the arrival of an enemy ; | and ordered his militia | in such a manner | that there was always | a great power | in readiness to march, | well-appointed and well-disciplined. | But that a suitable revenue | might not be wanting | for the support | of his fleets and fortifications, | he gave great encouragement to trade. |

3. Give brief explanations of the terms Sahara, Savannahs, Plateau of Tibet and Great Karroo.

4. State some of the routes which a person travelling to and from New Zealand might take, and give a full account of one of them.

5. What is meant by a Minister of State, a Spiritual Peer, a Knight of the Shire, a Lord Chancellor, a Chief Justice, an Admiral, a Field Marshal, a Regent, and a Governor-General ?
Name some eminent persons who have filled any of these offices, and say when they lived.

6. Recount the chief incidents in the reign of Elizabeth.

7. It is said in the 'Instructions to Inspectors,' that, beside the usual course of instruction, an excellent school 'seeks by other means to be of service to the children who attend it.' Can you name any such means, and say which of them are likely to be most effective ?

8. In some countries the public teachers are absolutely forbidden to make use of corporal punishment in any form. Say by what other means it is possible to maintain discipline under such conditions.

9. Name the following notes after they have been *once* sung or played :—(*Ear Tests.*)

In the last exercise, which notes are half the time value of the others ?

10. Find, by Practice, the cost of a fence 3 furlongs 9 poles $2\frac{3}{4}$ yards long, at £205 6s. 8d. per mile. Ans. £83 1s. 11d.

11. An equal number of sovereigns, half-crowns, and pence amount to £19 3s. 11d. What is the number ? Ans. 17.

12. (*Men only.*) Write out Euclid I., 45.
Prove the corollary to this Proposition.

(*Women only.*) Mention any provisions of the Code for the maintenance of health in elementary schools, and describe the precautions which you would take on the appearance of infectious disease.

13. (*Men only.*) Solve $\frac{x}{3} + \frac{y}{8} = 41$; $4y - 3x = 0$.

Ans. $x = 96$; $y = 72$.

(*Women only.*) An agricultural labourer earns 15s. per week, and has a wife, and five children between the ages of two and ten.
State clearly how much per annum he ought to spend (*a*) on bread, (*b*) animal food, (*c*) clothing, (*d*) house-rent, and (*e*) fuel, and what contribution he could make to a benefit club to support him in sickness and old age.

14. (*Men only.*) A and B shoot by turns at a target, A puts 7 bullets out of 12 into the centre, and B puts in 9 out of 12. Between them they put in 32 bullets. How many shots did each fire ?
Ans. 24.

(*Women only.*) Mention different ways by which odds and ends of bread may be utilised, and write out, as for a young teacher, the recipes of half-a-dozen inexpensive dinners for a mistress and her pupil-teacher.

15. (*Men only.*) The side of a regular nonagon is 2,718 ft. Find the side of an isosceles triangle of equal area whose vertical angle is 40°. Ans. 8,154 ft.

(*Women only.*) Let in a calico patch not less than two-and-a-half inches square.

16. (*a*) What does the circumflex accent in French denote ?

(*b*) Account for these kindred forms:—êtable (Fr.), stable (Engl.), and give six other instances.

17. Translate into French :—
(*a*) Tell me what you know.
(*b*) Who will go ?
(*c*) This tea costs three francs a pound.
(*d*) Allow me to be your friend.

Fourth Week.

1. Paraphrase the following passage, and parse the words in italics :—

> *Hadst* thou but lived, though *stripped* of power,
> A *watchman* on the lonely tower,
> Thy thrilling trump had roused the land
> When fraud or danger *were* at hand ;
> By thee, *as* by the beacon light,
> Our pilots had kept course aright;
> As some proud column, though *alone*,
> Thy strength had propped the tottering throne :
> Now is the stately column broke,
> The beacon light *is quenched* in smoke,
> The trumpet's silver sound is *still*,
> The warder *silent* on the hill.

2. Analyse the following sentences, supplying the words that are understood.
(*a*) She reads slowly, but very distinctly.
(*b*) He is taller than I.
(*c*) Come as soon as possible.

3. Explain briefly the terms :—inferior planet, phases of the moon, perigee, morning star, and draw a diagram illustrating the second.

4. Name the principal productions of *six* of the chief Colonies of Great Britain, and classify their climates as temperate, tropical, or otherwise.

5. What is meant by '*Civil War*' ? Say when there have been *civil wars* in England, and give details respecting their origin, their chief battles, and their final results.

6. Give a short account of any *three* of these :—Magna Charta, The Reformation, The Great Revolution, Catholic Emancipation, The Reform Bill, The Repeal of the Corn Laws.

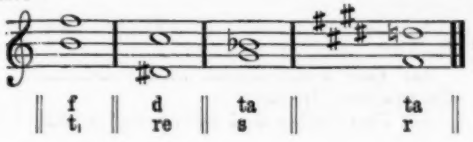
7. Sketch out the heads of a lesson on the Post Office—its organization and uses.

8. Name some of the most effective visible and tangible illustrations for use in teaching either (*a*) Notation, or (*b*) Practice.

SCHOLARSHIP OR FOURTH YEAR ROUTINE FOR MAY, 1894.

DAYS	FIRST WEEK			SECOND WEEK			THIRD WEEK			FOURTH WEEK		
	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.
MONDAY	Simultaneous Equations *or* Theoretical Needlework.	Revise History from 1660 to 1702	'De Bello Gallico,' Chapters 42 to 43, *or* 'La Jeune Sibérienne,' pp. 69 to 73	Algebraic Fractions — Beverages	Revise Dates from 1660 to 1730	'De Bello Gallico,' Chapters 44 to 46, *or* 'La Jeune Sibérienne,' pp. 74 to end	Algebraic L.C.M. (Theory and Practice) — Washing	Revise Dates from 1730 to 1800	'De Bello Gallico,' Chapters 47 to 50, *or* 'La Jeune Sibérienne,'	Algebraic Factors *or* Miscellaneous Arithmetic (*See Article*)	Revise Dates from 1800 to 1870	'De Bello Gallico,' Chapter 51 to end, *or* 'La Jeune Sibérienne,'
TUESDAY	Euclid, Book I. — Calico Sampler	General Geography of Asia	Science *or* Revision	Deductions upon Euclid, Book I. — Diagram of Chemise	Productions, Imports, Exports of British Empire	Science *or* Revision	Euclid, Book II. — Flannel Sampler	General Geography of India	Science *or* Revision	Deductions upon Second Book of Euclid *or* Marking	Literature and Penmanship	Science *or* Revision
WEDNESDAY	Cube Root — Square Root (*See Article*)	Latin *or* French Nouns and Pronouns	Drawing *or* Revision	Problems of Motion (*See Article*)	English Verbs	How to teach Writing	Latin *or* French Verbs	Parsing and Analysis (*See Questions*)	How to teach Arithmetic	Stocks (*See Article*)	Greek Roots, Affixes, and Prefixes	How to teach Grammar
THURSDAY	Quadratic Equations — Post Office Savings Bank	Revise History from 1702 to 1748	Parsing and Analysis (*See Questions*)	Algebraic G.C.M. (Theory and Practice) — Plain cooking for the Sick	History from 1625 to 1634	Study Table of English Literature.	Indices and Square Root of Algebra — Clothing and Washing	Revise History from 1748 to 1789	English Composition upon 'The Victorian Era'	Problems in Quadratic Equations *or* Miscellaneous Arithmetic (*See Article*)	Revise History from 1634 to 1640	Paraphrasing and Dictation (*See Questions*)
FRIDAY	Euclid, Book II. — Flannel Sampler	General Geography of Africa	Arithmetic (*See Article*)	Deductions upon Euclid, Book II. — Calico Sampler	Map of India	Latin *or* French Adjectives and Adverbs	Euclid, Book I. — Diagram of Flannel Petticoat	General Geography of British Isles	Stocks (*See Article*)	Deductions upon Euclid, Book I. — Flannel Sampler	Map of Australia	Compound Interest (*See Article*)
SATURDAY	Drawing *or* Revision	Science *or* Revision	Examination (Two Hours)	Music Easy Transposition *or* Tonic Solfa Time-names	Science *or* Revision	Examination (Two Hours)	Music Transcription from one time to another	Science *or* Revision	Examination (Two Hours)	Music Syncopation Compass of Voices Musical Terms	Science *or* Revision	Examination (Two Hours)

9. Describe the intervals formed by the following pairs of notes :—



10. Simplify $\frac{1\frac{13}{17} + \frac{91}{119}}{\frac{5}{8} + \frac{3}{11}} - \frac{133}{143}$. Ans. 1.

11. Two steamers leave a place at the same time for the same port, distant 1,260 miles. The faster steamer averages $11\frac{1}{2}$ miles an hour, and arrives at the port 28 hours before the other. What did the latter vessel average an hour? Ans. 9 miles per hour.

12. (*Men only.*) Write out Euclid II., 13.
The sum of the squares on the sides of a triangle is double the sum of the squares on the median and half the base.

(*Women only.*) What are the chief materials of which clothing is made? And which of these is the most essential in our climate, and why?

13. (*Men only.*) (*a*) Solve $\frac{a}{x} + \frac{b}{a} - \frac{1}{3x} = 0$.

Ans. $(1-3a)\frac{a}{3b}$.

(*b*) $\frac{p}{x} + \frac{x^2-p^2}{x+p} = x$. Ans. 1.

(*Women only.*) State fully what are the objections to a diet either exclusively vegetable or exclusively animal.

14. (*Men only.*) I bought a certain number of eggs at 2 a penny, and the same number at 3 per penny. I sold them at 5 for 2d. and lost a penny. How many did I buy? Ans. 60.

(*Women only.*) Explain the terms *fibrin*, *albumen*, *gelatine*, and describe the distinctive value of each as a constituent of animal food.

15. (*Men only.*) Show that the area of a triangle whose sides are in the ratio of 3 : 3 : 4 is greater than $\frac{1}{3}$ of the square described on one of the shorter sides. Ans. $\sqrt{5} : 2$.

(*Women.*) Mark on calico (cross-stitch) your initials.

16. Write out 'The Desire.' What is it an explanation of? Show in parallel columns that it is a faithful paraphrase.

17. What are the Practical Advantages of a book of Common Prayer?

N.B.—(1.) We have made arrangements, merely to suit our own Readers, and with no desire to interfere with existing agencies, for tuition based upon these articles, routines, and questions, by experienced teachers and graduates. Names of intending pupils should be sent to DR. G. BEACH, M.A., *Stanley Mount, Macclesfield.* The fees (*to be paid in advance*), are 1s. 6d. per week, or 5s. 6d. per month, or 15s. 9d. per quarter.

(2.) *For Correspondence, see end of Certificate Article.*

TEACHING NOTES ON 'THE LIFE AND DUTIES OF THE CITIZEN.'

By the authors of 'Hughes's Constitutional Reader: a Series of Lessons on the Life and Duties of the Citizen.' (Published by Joseph Hughes & Co., Froebel House, St. Andrew's Hill, Doctors' Commons, E.C.)

LESSON XXI.

ASSOCIATION OF WORKERS.

I. Objects of Association.

Labourers in many of the industries of the country are associated—

(1) **In their work**—in Trades Unions.

(2) **In the production and distribution of commodities**—in Co-operative Societies.

(3) **For mutual help in times of need and sickness**—in Friendly Societies.

II. Trades Unions.

These are associations of workers as workers.

(1) **Their History.** The First Trade Union Congress was held in 1868. A Royal Commission sat on Trades Unions in 1869. At this Commission it was pointed out that they existed for two purposes:

(*a*) For the benefit of their members in times of illness or stagnation in trade.

(*b*) For the combination of working men in the protection of their interests.

The 25th Annual Trade Union Congress sat at Glasgow in September, 1892. At this Congress 600 delegates represented about 2,000,000 workmen. Notice the enormous growth in a quarter of a century.

(2) **Their Work.** Their object is to secure for their members (*a*) mutual protection; (*b*) what their leaders consider a fair wage; (*c*) acceptable conditions of labour; (*d*) the employment of as many workpeople as possible; (*e*) the limitation of hours of labour; (*f*) assistance to members out of work; (*g*) a supply of information concerning the state of the various trades, etc.

(3) **Strikes** are brought about when Unionist leaders believe that the wages given in any particular industry are too low, or when a proposed reduction seems unfair. When a strike is declared, the men leave their work, and refuse to resume it until an understanding is arrived at.

[Instance, the London Dock Strike of 1889, the Durham Coal Miners' Strike of 1892, the Hull Dock Strike, and the protracted Coal Strike of 1893.]

Trades Unions are, perhaps, now best known owing to their action in strikes, but they may and do exist without strikes.

(4) **Lock-outs** are brought about when masters refuse to allow men to work because the latter will not accept the master's terms. Employers also have Unions like men's Trades Unions, for the protection of their interests.

[Instance, Coal Owners' Confederation.]

(5) **Conciliation and Arbitration** are always to be preferred to strikes and lock-outs, as they entail less suffering on women and children, and are productive of far less bitterness of feeling between capitalists and labourers. By their means differences of opinion are adjusted, and both time and money are saved.

[Explain and refer to the Board of Arbitration presided over by Lord Rosebery in November, 1893, and the Board now formed under Lord Shand.]

III. Co-operative Societies.

These exist for two purposes—

(1) **The production of Commodities.**

(2) **The distribution of Commodities.**

The former of these purposes is not so commonly worked out at present as it might and probably soon

will be. Not a large proportion of workers at present share in the profits derived from their work.

When Co-operative Societies are talked of, they usually stand for societies for the distribution of commodities. There are in all 1,655 Co-operative Societies in the United Kingdom. The chief features of the system are—

(*a*) Ready-money transactions.

(*b*) The purchasers themselves—if shareholders—have a share in profits.

(*c*) They are a sort of savings bank—interest being paid on shares at rate of 5 per cent. per annum. Co-operative societies are said to do harm to small tradesmen and shopkeepers.

IV. Friendly Societies, or—

(1) **Benefit Clubs** exist for the purpose of mutual help. A member of a friendly society secures for himself an allowance of money, and often medical assistance in times of sickness by the regular payment of a small subscription. [Instance, Oddfellows and Foresters' Societies.] Every workman who cannot save enough to provide for his family when he is ill, should be a member of a friendly society.

(2) **Medical Clubs and Dispensaries** secure to their members medical attendance and medicine in times of sickness. [Instance any known case.]

V. Habits of Industry, etc.

Conclude lesson by pointing out importance of

(1) **Working industriously** when able to work.

(2) **Exercising thrift** by saving something—if only a little—regularly.

(3) **Cultivating self-dependence** by making use of any available voluntary system of self-protection.

Read Lesson 42, 'C.R.'

LESSON XXII.

THE STATE AND LABOUR.

I. State Regulations affecting Labour.

Labour not always 'free,' as at present. In reign of Elizabeth, Justices of the Peace could fix all rates of wages, and act despotically in other matters concerning labour. Still, however, legal enactments exist concerning labour and labourers. The principal are—

(1) **Factory Acts,** which have been in existence since 1802, and have undergone modifications in Parliament from time to time since that date. Changes took place in 1819, 1825, 1833, 1850, 1867, and 1871. (See 'C.R.' pp. 194, 195.) All previous acts summed up in 'Factory and Workshop Act of 1878,' which (*a*) provides for health and safety of workers; (*b*) establishes regulations concerning meal-times and overtime; (*c*) relates to the work of inspectors and doctors; (*d*) makes clear the meaning of all its regulations.

(2) **Mines Acts** date back to 1842, and provide for—

(*a*) The exclusion of women and boys under ten from underground work.

(*b*) The appointment and employment of Government Inspectors.

(*c*) The boring and use of double shafts for coal mines.

(3) **Women's and Children's Labour** has been the subject of legislation since 1833. The general effects of such legislation have been—

(*a*) To forbid the employment of girls and women at occupations which are clearly unsuitable to their natures.

(*b*) To forbid the employment of children under a certain age.

(*c*) To secure the education of children up to a certain standard in elementary schools.

(4) **Dangerous Employments**—such as mining, smelting, and working near to machinery in motion, have very properly been made the subject of imperial statutes. Furnaces and machinery in motion must be enclosed, so that workers cannot fall into them. The Employers' Liability Acts secure for the worker compensation from their employers if the latter are proved to have been guilty of negligence in the matter of affording necessary protection. [Refer to the Employers' Liability Bill of 1893–4.]

II. Labour Department of the Board of Trade. [See Chap. XXII. 'C.R.']

This department publishes two papers, which give information concerning the condition of workers in the various industries of the country.

(1) **'The Board of Trade Journal'** contains reports of the trade and business of the country generally, and often supplies valuable information to workers on the look-out for employment.

(2) **'The Labour Gazette,'** started in May, 1893, and to be issued monthly, 'is a journal for the use of workmen and of all interested in obtaining prompt and accurate information on matters affecting labour,' but 'does not concern itself with matters of opinion.'

III. Government Labour.

The central government employs its own labourers in

(1) **Dockyards,** *e.g.*, Chatham, Portsmouth, Devonport.

(2) **Arsenals,** *e.g.*, Woolwich.

(3) **Occasional Public Works,** *e.g.*, Light Railway in Ireland.

In all these the work done is directly supervised and paid for by the State, which fixes its own terms, and, in the two former cases, rewards long service by pensions under certain conditions.

IV. Municipal Labour.

It is becoming common for Municipalities, County Councils, Town Councils, and Vestries to employ their own labourers instead of accepting outside contracts. The London County Council has lately adopted this plan on a large scale. Local bodies

are granted borrowing powers to enable them to start public works for the unemployed (1893). The State does not at present undertake to provide labour for the unemployed. In all cases, municipalities should set a good example to private employers by treating their employees justly. [This part of the lesson should be developed to suit the locality in which it is given.]

Read Chap. 43, 'C.R.'

LESSON XXIII.

THE MANAGEMENT OF BUSINESS AND INDUSTRY.

I. Illustrations.

[Much of the success of this lesson will depend upon the suitableness of the illustrations employed. Such illustrations must be judiciously selected so as to appeal to the pupils. Particular neighbourhoods will supply their own illustrations. The staple industry of the town or locality in which the lesson is given will, in most cases, afford the best, because the best known illustrations. Manufacturing, mining, and agricultural occupations will necessarily be drawn upon to a great extent, but in some cases railways, shipping businesses, and wholesale or retail stores will perhaps afford more suitable, because better known illustrations. In any selected business or industry the workers must be classified before the different kinds of management or supervision can be understood.]

II. Classification of Workers.

[Lead pupils to think of the various classes of people concerned in the business or industry selected for illustration.] In most cases they may be divided as follows :—

(1) **Capitalists,** who supply the money for carrying on business, either as shareholders in a company, or as private individuals.

(2) **Directors,** who are employed by capitalists to direct expenditure.

(3) **Office Managers,** with a staff of clerks employed in book-keeping and general desk-business.

(4) **Manual Workers,** with foremen at the the head of shops, departments, or groups.

The above is a general classification, and, of course, does not apply to agriculture. As in very many cases the working of railways will probably be used in illustration, the different classes of workers in railway industries may be thought of in detail and classified as follows :—

(1) Capitalists.
(2) Directors.
(3) Engineers and surveyors—(*a*) at works, (*b*) on lines.
(4) Office managers, traffic managers, railway works managers.
(5) Chief clerks, office clerks, booking clerks.
(6) Station masters, inspectors, guards, ticket examiners, porters.
(7) Engine drivers, firemen, and engine cleaners.
(8) Coach cleaners and platelayers.

[It should be pointed out how promotion is secured and carried on in these classes, and in which classes foremen are employed.]

III. Qualifications for a Manager's Post.

Special qualifications are required to fill special positions; but all positions of trust and responsibility in connection with the management of the various branches of industry demand certain qualities of character and temperament. The first qualification for the post of manager, manageress, foreman or forewoman is—

Honesty, integrity, uprightness of character. This quality should, of course, be cultivated by all; but no workman or workwoman can expect promotion in any industry who is not known to be of unquestionable honesty. [Develope this point, and mention some known results of the abuse of confidence placed in managers from time to time.] Then—

General Intelligence of a high order is demanded in all those who are placed in positions of trust. Capitalists, directors, or employers of any kind must be assured that their manager or foreman is capable of adapting himself to circumstances, and of dealing successfully with unexpected difficulties. [Instance, difficulties which may arise in machine-rooms, workshops, mills or mines.]

Exceptional Skill in the particular branch of industry or trade at which a manager is employed is also expected in one who is placed in the position of overlooker. Not only sound common sense in dealing with general cases must be at command, but special technical knowledge which is capable of suggesting a suitable solution of any difficulty peculiar to the trade must be forthcoming. This is of vast importance to the easy conduct of any business. [Give instances.]

Tact in the management of subordinates must not be overlooked in the selection of the head of a room, a department, or a party of workers. An easy dignity should characterize a manager of men or women. His rulings must be kindly but firmly enforced, and there should never be an appeal against his decisions. Blustering assertions of self-importance must be avoided on the one hand, as much as a lack of decisiveness on the other. [Mention cases.]

Enthusiasm is, lastly, a quality of temperament which employers rightly and wisely cherish in those whom they honour with the dignity of office. A whole-hearted interest in the success of the business, and an untiring energy in its promotion, are to be looked for in any candidate for a managership. [Enlarge upon this.]

Read Chap. 44, 'C.R.'

LESSON XXIV.

A GOOD CITIZEN.

I. In the Home.

The very name **citizen** implies a community—and that a civilized community. In these days no citizen can or ought to live a life of selfish solitude. Each one is, to a greater or less degree, his 'brother's keeper.' Good citizenship has its beginnings in the **home**. A good father, husband, or brother makes a good citizen. A bad father, husband, or brother can

never be a good citizen. The same qualities of mind and character are required in the community and in the home—unselfishness, obedience to authority, regard for the desires of others, agreeable personal habits, etc.

II. In the School.

The school plays an important part in the formation of character as well as in the imparting of knowledge. Objectionable traits in the characters of individuals are 'educated' out of them. Pupils learn to submit to authority, and to cultivate the habit of working for the 'greatest good to the greatest number.' Important lessons in citizenship, in its best sense, are learnt in school.

III. In Business.

The rules of conduct learnt in the home and in the school are put into practice, and are still further impressed when the teachable young citizen starts upon the selected work of life. Primarily the working boy and man, perhaps, think they work to secure the means of living. To take only this view of our work in life is degrading. Each one, by working, is serving his fellow-citizens and his country. The more effectually this truth is impressed, the better will be the work done, and the higher the motive from which enthusiastic application proceeds.

IV. In the Municipality.

The boy who has had a wholesome home-training, who has made the best use of his school days, and who, having become settled in his occupation, is ardently working with a view to public usefulness, and the success of his industry, as well as for his personal well-being, is not likely to forget his duties to the town, city, or locality in which he lives. When the time arrives he will

(1) **Earn his vote.**
(2) **Claim his vote**—on local questions; and
(3) **Use his vote** intelligently.

Later on he may perhaps

(4) **Seek election** on local bodies, *e.g.*, Vestry or Board of Guardians.

Municipal life has grown much in recent years. and is becoming annually more extended. It can only be effective in educating individual citizens up to a satisfactory standard of interest and efficiency, if individual citizens themselves are willing and anxious to avail themselves of the means of education, enlightenment, and usefulness which municipalities place before them. [Instance, Town Halls, Free Libraries, Evening Classes, etc.]

V. In the State.

Interest in and work for the municipality lead up to interest and participation in imperial matters. As local government in all its branches can be traced up to central sources, so a right use of our voting powers in local matters leads to an intelligent use of the same powers when State interests are at stake. The man who uses his influence most intelligently in the parish or township will be most likely to act and vote intelligently in parliamentary elections. [Illustrate by reference to the many local men who become M.P.'s. They are educated in the municipality for services to the State.]

VI. In the Empire.

(Remind of extent of empire—$\frac{1}{5}$ of population of world, and $\frac{1}{7}$ of land area.) The humblest parliamentary voter's influence extends over the whole empire. Our policy throughout colonies, dependencies and protectorates is shaped by individual votes Hence need for interest, careful study, and a right decision before voting at a parliamentary election. None for a party: all for the State and the Empire.

VII. In the World.

The British citizen's interests are co-extensive with the world. Think of Lesson 18 on our relations with foreign powers. Think of importance of right policy with reference to foreign relations. That policy is our policy, and is shaped by individual citizens. The good citizen learns his duties in the **Home** and the **School**, develops them in **Business**, and carries them out in his relations to the **Municipality**, the **State**, the **Empire** and the **World**.

COMING MEN.

VIII.—MR. ALLEN CROFT.

President of the National Federation of Assistant Teachers; President of the Nottingham and District Teachers' Association; Vice-President of the Nottingham Board Certificated Assistant Teachers' Association.

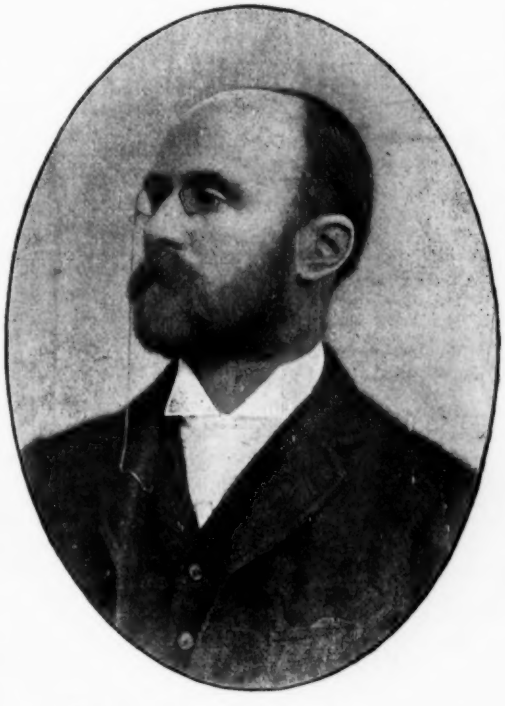
It was with no small degree of pleasure that we received an intimation from our Editor that the subject of the next sketch in the series of 'Coming Men' was to be Mr. Allen Croft. Those to whom Mr. Croft is familiar will appreciate the frame of mind in which we hastened to fulfil our mission. A rapid journey to Grantham, an exchange of compartments, and very soon we arrived at the town of lace. Nottingham does not wear the business aspect of years ago. Fashion has not been altogether kind to its industry, but it is withal a town which repays a visit. Our destination is 221, Woodborough Road. And what a welcome one receives. The pleasantly situated residence of Mr. Croft is pervaded with an air of N.U.T.ism. It has been on numerous occasions the privilege of its host to entertain the great ones of his profession, and the contagion of his genial hospitality permeates every member of his household.

To be connected with the powerful organization of the teachers is to possess the open sesame to Mr. Croft's cheery domicile.

The chief characteristic that he owns is his remarkable aptitude for occupying his position as a host. To this fact many prominent Unionists (including this year's President) can abundantly testify. On proceeding to discuss the object of our visit we found that Mr. Croft was a Yorkshireman, as he claims the village of Brandesburton, near Beverley in Holderness, Yorkshire, as his birthplace. Here he was born some thirty-two years ago. At eight years of age he entered the Emmanuel Endowed School, Westminster, London, and after going through a course of study for a period of ten years, entered St. John's Training College at York. On leaving college Mr. Croft commenced his career as a primary school teacher at Penrith. Here it was that he first became con-

nected with the National Union of Teachers. In June 1884 he accepted a position under the Nottingham School Board, and is now engaged as the Principal Class Master at the Bath Street Board School in that town. It was not long before he commenced to display that interest and energy in professional questions which have brought him into the front rank of Unionists. In the years of 1887 and 1888 Mr. Croft began to direct attention to the position of the Assistant Teacher in that determined manner which has always characterised him.

His efforts led to the formation of the Nottingham Certificated Assistant Teachers' Association, the first association of this nature to be established. He was unanimously elected its first President. In the year 1889 Mr. Croft persistently drew attention to the utility of assistant teachers' associations, contributing a remarkably able article to the *Schoolmaster* on the subject. His efforts in this direction were important in assisting the development of the movement.



Faithfully Yours
Allen Croft

It is noteworthy that during the early period of the existence of the Nottingham Certificated Assistant Teachers' Association, Mr. Croft delivered a paper on the subject of uniting the forces of the then existing and future organizations of Assistant Teachers.

The principle of Federation now adopted by these associations, and with which Mr. Croft was so closely connected, displays the foresight and grasp of the man. It must not by any means be assumed that his action in these matters was in any way opposed to the National Union of Teachers.

His work in the Nottingham branch of that organization is striking testimony to his belief in the Union. In 1890 he was elected Vice-President of the local association, and this year has been unanimously chosen as President of that influential body. The respect and confidence which he obtains from his colleagues is striking, and his influence is such that to think of Nottingham is to unconsciously revert to the name of Croft.

During recent years he has been much in evidence on account of his contributions to the press and his work in the local associations in connection with the 'Concerns of Assistants.' He has laboured hard (and with no little success) for the establishment of a more reasonable remuneration for the members of his community, and the fact that the Nottingham School Board is classed with those who have been wise enough to remove obnoxious and uneducational corporal punishment regulations from their Code of Regulations is in no small measure due to his assiduous labours. The Corporal Punishment question has claimed much of his energy, and the able and conclusive argument which he has been able to adduce for the abolition of restriction in this particular is prominently illustrated in the splendid paper which he prepared for the Assistant Teachers' Conference at Derby.

Mr. Croft is pre-eminently a representative of the Assistant Teacher. The commencement of the national movement which led to the first conference of Assistants at Sheffield brought him into greater prominence. He was a conspicuous figure at that Conference. When, in the following year, the Assistant Teachers met at Nottingham, the desire to do honour to the man to whom they owed so much actuated them, and here it was that Mr. Croft was first selected as a candidate for the N.U.T. Executive. His action at the Nottingham Conference in support of Federation will be within the recollection of many. Again at Derby, in the month of October of last year, he piloted the Federation scheme, and was rewarded with a brilliant success. The honour of becoming the first President of the National Federation of Assistant Teachers could have fallen on no more worthy shoulders, and the Conference showed its appreciation of his efforts in electing him to that position.

Such is the brief summary of what we gathered of Mr. Croft's connection with the Assistant Teachers' movement.

In connection with the National Union of Teachers his work has also been extensive. We have already referred to the position he holds in the local association.

For the past seven years he has been a member of the General Committee of the Association, and has served four years as Secretary of the Organization Committee. He has always been an earnest labourer on behalf of the Union's Benevolent Funds. His work in his own Association and his ready grasp of national questions have naturally brought him before the notice of other branches of the Union, and he has been invited to address numerous asso-

ciations on Union questions. His speeches at important gatherings in Birmingham, Burton, Derby, Sheffield, Leeds, Liverpool, Halifax, Bradford, Cardiff, Worcester, etc., are examples. He was a prominent figure in the debate on the Corporal Punishment resolutions at the Leeds conference in 1892, and was again to the fore at the Liverpool Conference of 1893. In this year he unsuccessfully contested for a seat on the N.U.T. Executive, but the facts that he was but second on the list of non-elected candidates, and that he polled 3,714 votes, evidence his popularity. In the election just concluded, although he increased his poll to 4,881 votes, he, singularly enough, again occupied the fatal 26th place.

From what we have outlined it will be seen that Mr. Croft is an example of the many who, though not directly in charge of the machinery of the Union, still display a capacity for work and an interest in the welfare of their fellows that is commendable.

We now proceeded to elicit from him some of his views upon educational matters. In reply to a query respecting the policy of the N.U.T., he said:—

'The N.U.T. has, ever since its inception, proved an admirable organization for the purpose of watching the interests of education. In this direction its members have made noble sacrifices. The conditions of many of its members, however, cry for immediate attention, and the Union must devote much of its energy and influence—and it has plenty of each—towards improving the position of the educator.

'I am strongly of opinion that the N.U.T. does not provide sufficient tangible benefits.'

Respecting the constitution of the Executive of the Union, he ventured the opinion that the Executive should consist of men who actually feel the pinch of present circumstances.

'I would facilitate the retirement of,' said he, 'those whose chief interest is served by being newspaper directors, proprietors of secondary schools, and secretaries of training colleges. Those who can represent the teachers who are suffering from the many defects of our educational system are those who themselves are suffering.'

Speaking of the work of the N.U.T. on behalf of Assistant Teachers, he remarked:—

'I am extremely grateful for what the Union has done for the Assistant Teacher, but whilst granting that the inclination to assist the Assistant existed years ago, I am convinced that the greatest amount of attention that has been devoted to the interests of this class is directly and naturally due to the action of the Assistants themselves. The number of Assistant Teachers on the Executive of the Union should still be increased.'

'You are, of course, aware,' we said, 'that the Federation of Assistant Teachers has come in for an amount of severe criticism?'

'Yes,' was his reply; 'but it is perfectly ridiculous to imagine that the Federation would commit suicide by adopting a policy hostile to the Union. The opposition of three or four prominent assistants to the principle of Federation, and their subsequent action since its establishment, lead me to the conclusion that they do not properly represent the feeling of the community of Assistant Teachers.'

Further conversation informed us that Mr. Croft was in favour of an increased subscription to the N.U.T., and of a proper allocation of the funds of the Union to its various departments.

He deprecates emphatically the system of employing lady teachers in boys' schools, and of appointing one head teacher to supervise more than one department. He is full of admiration for the action of the *Schoolmaster* in its struggle for 'Security of Tenure.'

We spent some time with Mr. Croft, and had the opportunity of meeting with several of the most influential of the Nottingham teachers. The opinions expressed by these gentlemen upon the value of Mr. Croft's services, and the esteem in which it was evident they held him, impressed us greatly. An interesting feature of our visit was the pleasing welcome we received from Mr. Croft's little ones, and it was exceedingly amusing to learn from them, in their innocent manner, of the various individuals who stand high in the Union's ranks and whose acquaintance they had made. We left Nottingham feeling that we had parted with a happy family, and with a man whose gentlemanly bearing, extensive general knowledge, and broad grasp of educational questions stamp him as one whose services to the cause cannot be over-estimated, and whose future career will certainly be a most ample justification for his position in this series of articles.

PAPERS FOR PUPIL TEACHERS.

BY JOHN ADAMS, M.A., B.SC., F.C.P., ETC.
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BLACKBOARD DRAWING—MECHANICAL AIDS.

You must not suppose, from what has been said in the preceding article, that mechanical aids are to be condemned. The duster is a mechanical aid that is condemned simply because its use involves a loss of time. Other mechanical aids, on the other hand, save time, and are therefore to be commended. Saving of time ought to be always the ultimate test of the value of any aid in blackboard drawing.

Some boards, for example, have a horizontal straight-edge that is fixed in grooves at the sides of the board, and can thus be easily moved up and down, and always ensures an accurately horizontal line. In the case of boards fixed to the wall, there may even be two such straight-edges—one horizontal, the other vertical, the vertical straight-edge being so arranged in its grooves as to pass freely over the horizontal straight-edge.

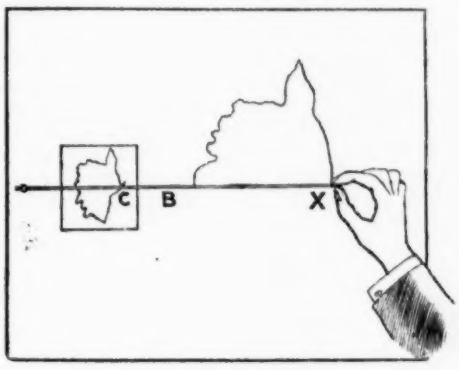
By this means an accurate right angle may be drawn, but only by means of horizontal and perpendicular lines. Now, a right angle is often wanted in other positions, and is one of the hardest things to draw. In the geometry lesson T squares and set squares may be used, because the teacher can thus show the pupils how to use those instruments on their own drawing papers; but in ordinary class teaching the teacher must be able to rely upon his hand and eye alone for a right angle in any position.

The source of difficulty in drawing a line at right angles to an oblique line is the closeness of the draughtsman to his drawing, so in practising the right angle the teacher should always test his work by stepping back to get a better view. To be able to draw a correct right angle is reward enough for much practice.

Boards made of glass or slate are frequently ruled off into squares of, say, two-inch side, by delicately cut lines, while wooden boards may have the same kind of ruling put in with a different kind of black from that on the general surface. In either case the markings do not disfigure the board, and are of the utmost service in helping the teacher, who can by their means draw absolutely accurate horizontal and perpendicular lines, parallel lines, lines of exactly the same length at different parts of the board, squares, and other symmetrical figures. Even in drawing ordinary objects and maps this permanent ruling is useful in guiding as to form and proportion, while the freedom of the drawing is maintained, and, above all, no time is wasted in ruling.

There is a special aid in blackboard drawing, called a pantagraph. It is an instrument by means of which a small drawing may be accurately reproduced on a much larger scale. For example, a small map may be fastened at the side of the board, and by means of this instrument transferred by chalk upon the board itself, so as almost to fill it. The ordinary and most accurate kind of pantagraph is made up of sets of parallel rulers, and is very cumbersome to use. The kind described here, while not quite so accurate, is sufficiently accurate for all practical purposes, and is much less complex.

It is indeed ridiculously simple, demanding, as it does, nothing more than a drawing-pin, a stout elastic band, and an old pen-point. You will understand how it works from the drawing given. A is a



drawing-pin which fixes the elastic band B to the board. In its unstretched state B should not be longer than one-third of the length of the board. When not in use, B can be left hanging from A without in any way interfering with ordinary board work, while it is ready for use at a moment's notice. C is a pen-point fixed in the elastic band, and serves as a pointer. The drawing to be copied is fixed on the board to the right of A, so that the pointer, C, just touches the extreme left of the drawing before the elastic band is stretched. The teacher then takes the elastic band in his hand, holding the chalk, as at X, and, keeping his eye fixed on the pointer C, stretches the band so as to make the pointer trace out the outlines of the drawing. As he does this the chalk, of course, traces out on the board the same outlines, only much larger. The chalk drawing is quite accurate about the middle parts, somewhat out of drawing at top and bottom, but, generally speaking, is quite a creditable reproduction of the original.

Coloured chalks are mechanical aids which are in some ways to be avoided. To attempt to produce by their means 'pictures' on the blackboard only results in absurdity. No doubt you can draw your tree with a brown trunk and green leaves, and may even throw in a few ochre oranges. But however correctly the colours may read, they never by any chance convey in actual drawing even an approximately true notion of what the tree really looks like in nature. If you want, indeed, to see blackboard drawing at its deadest failure, all you have to do is to add to your tree a background made up of mauve hills and a depressingly black and blue sky.

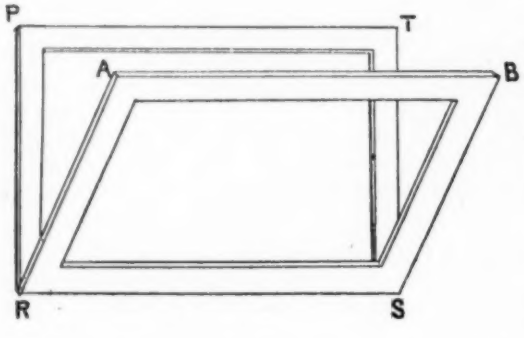
The true place for coloured chalks is in the drawing of diagrams—maps, of course, being included among diagrams. Here they are of the utmost service. In the first place, they give clearness when a drawing involves a great number of lines. This advantage is generally recognised, but the second advantage, though of immense importance in teaching, is seldom noticed. This is the means of easy reference supplied by the various colours. When in a complicated drawing you wish to refer to a certain line, you usually indicate it by a letter at each end. Now, to refer to a line as M P in a drawing which

looks like a pic-nic of all the letters of the alphabet, demands a considerable expenditure of time on the part of the pupil, to say nothing of the time spent by the teacher in labelling the different points. Nor must we forget the not unusual mistake of using one letter twice, to the great confusion of all concerned.

On the other hand, 'the green line' is easily said, easily seen, and requires no name at all on the board. A good way to test the value of this method is to apply it to your own Euclid lesson on the blackboard. You will find it much easier to keep troublesome lines out of each other's way than by the help of the mere letters. In very complicated drawings the same colour may have to be used in different parts, but a tap of the pointer, and the addition of '*this* green line,' easily gets over the difficulty. If different parts of the same line have to be used separately, they should have different colours; in this case the whole line may be referred to as 'green plus blue' or 'green plus yellow, plus red.'

Speaking generally, then, coloured chalks should be kept for *line* drawings. In geological and engineering diagrams flat shading may be laid on by rubbing in with the flat side of the coloured chalk; but even here line-shading gives a much better effect.

You have all seen what are called 'drawing slates,' little framed oblongs of dim glass, behind which drawings are placed so as to be seen through the glass upon which they are traced by the child. This principle may be applied to the work of teaching if



the glass be sufficiently large. R S T P is a slab fixed to the wall; R S B A is the frame containing the dim glass upon which the chalk writes freely; R S is the hinge. Between the slab and the glass any drawing can be placed; the glass is then brought close up to the slab and fixed there, so that the drawing is seen through it. The advantage of this is that the accuracy and completeness of a prepared diagram may be combined with the freedom and freshness of a drawing completed before the pupils. For example, the drawing may be merely the outline of a map—say of England. The lesson may consist in filling in the rivers, the mountains, the towns, as the case may be. Speaking generally, the permanent drawing gives the broad outlines in their true relations, leaving details to be filled in as the needs of the teacher demand.

If it is desired to use the ordinary white chalk, the permanent drawing should be made on black paper by means of flake-white. If coloured chalk is to be used, a white paper with ordinary charcoal drawing suits well enough.

This 'whiteboard,' as it may be called in contradistinction to its black brother, gives a fair chance for the use of colour in landscape and object drawing. But though I have seen excellent work done in this way, it is hardly of much practical use to tell you about it. You are not likely to get a board like this till you have a school of your own. It is well, however, to know what is being done, and to have an ideal towards the attainment of which the good draughtsmen among you may strive.

But what about the bad draughtsmen—the great majority? Let them practice at every spare moment (prepared chalks cost only 9d. the gross), so as to get up typical familiar objects. Every pupil-teacher who has any self-respect ought be able, at a moment's notice, to draw a man, a horse, a ship, a cat, a dog, and a dozen or two similar things. Observe, I say, *a* man, *a* ship, and so on, not this or that man, or a man in this or that position. You may be able to draw a ship looking at it from the side, and yet quite unable to draw it 'end on.' But for all that you can draw a ship. Of course, a really good draughtsman will not be content with this, but will want to show an object in any position that his lesson may demand; but a pupil-teacher who can draw an object in only one, and that the easiest, position, is infinitely better than one who cannot draw at all.

Every pupil-teacher of spirit should aim at being an excellent draughtsman on the blackboard. Some ambitious teachers groan that there is no room for talent in their profession; everything is so mechanical, so easily understood. Now here is a splendid opening to distinction. If you learn to draw even passably on the blackboard, you are certain of distinction, even in a profession swarming with D.'s, First and Second-class Art Certificates, Second Grade Certificates, Art Teacher's Certificates, and all the other hard-to-get and harder-to-understand honours of the Science and Art Department.

NEW COMPOSITION STORIES.—STANDARD V.

Suitable for 'Unseen Tests' in Reading also.

155.

NOT TO BE CAUGHT!—A gentleman had in his employment a gardener who was a skilful botanist, and who knew every seed there was. His master had often tried to puzzle him. 'I've got him this time,' he said once to some friends at the dinner-table, at the same time showing them a small packet which contained the dried roe of a herring. The gardener was sent for. 'I suppose you know this seed?' said the gentleman. 'Yes; why not? They are very rare seeds indeed,' was the reply. 'How long will they take to come up?' said the gentleman, suppressing a laugh. 'About a fortnight,' was the answer. Two weeks later the same friends were again at the house. After they had dined, the gardener came in, and said, 'Sir, the seeds have just come up.' 'In-

deed!' the gentleman exclaimed; and he and his friends went to the garden to examine them. The gardener lifted a glass shade, and showed them three rows of pickled herrings' heads peeping out of the ground. Everyone laughed, including the gentleman. The only one who kept a grave face was the gardener.

156.

He Got Nothing.—The late Archbishop of York had been to recruit his health at a watering-place, and on the morning of his departure asked for his bill. It was a very heavy one, but he paid it without complaint, and gave the waiter the change out, which was a shilling. Just as he was leaving the hotel, the landlord came up to him and said: 'I hope your lordship has had the change and rest you were so much in need of?' 'Indeed, I haven't!' replied the Archbishop. 'The waiter got the change, you've got the rest, and I've got nothing.'

157.

A Thief's Cunning.—A tradesman who sold umbrellas once received the following message:—'Please send Doctor Jones half-a-dozen of your best silver-mounted umbrellas.' He sent them as directed by his boy, who presently returned, and said, 'I have left the umbrellas with the servant, as the doctor was out.' Soon after the boy had left, a man knocked at the doctor's house, and upon the door being opened, said to the servant, 'A boy left a parcel of umbrellas here just now, didn't he?' 'Yes,' said the maid. 'How silly of him to make such a mistake; they were to be left at Mr. Smith's, in East-street.' The servant gave him the parcel, and the thief made off with it.

158.

Where There's a Will There's a Way.—The following anecdote is related of a nobleman who recently died:—He had one day appointed to meet a friend at a small country station, as they intended to travel in the same direction. The train arrived, but not the friend. Away in the distance his carriage was seen driving along at a gallop. It would take about five minutes to get to the station. The nobleman entreated the station-master to stop the train for a few minutes, but the latter refused, as the train was already late. Words ensued, and the nobleman at last passionately exclaimed, 'We will see about that,' and sat down between the rails in front of the engine; nor would he move from the spot until his friend had got safely into the train.

159.

Discretion the Better Part of Valour.—A Cashmere merchant came to Cabul with some handsome shawls, and deposited them with a merchant there. Upon demanding his shawls a few days after, he was met by the Cabul merchant with a flat denial of having ever received them. He appealed to the Judge, who directed him to repair at a certain hour next day to the shop of the Cabul merchant. On the morrow the Judge proceeded in great state to the shop. When he was opposite to it, recognising the Cashmere merchant, he expressed great pleasure at seeing him, and invited him to his palace. A few hours afterwards the Cabul merchant appeared to implore the pardon of the friend of the Judge, not only restoring the shawls, but forcing upon him a large sum of money also.

160.

The Bloodless Battle.—In the year 1432 Hamburg was besieged by a great army; and the inhabitants were terribly afraid, for they could not hope to hold out long. A council of the chief citizens was held to consider what they should do. Someone suggested that they should send out the little children, for when the soldiers saw them the sight might melt their hearts, and induce them to spare the town. Acting upon the suggestion, the children were brought together and put in order in the streets, the city gate was opened, and they were told to march out to the army. The soldiers were surprised to see the gate swing open, and still more so when they saw the little children clad in white robes come forth; and when they heard the pattering of their feet, and saw the little ones draw timidly up to their tents, their eyes began to fill with tears; they threw down their arms, and gathering beautiful branches off the cherry-trees full of fruit, sent back the children to their parents with answers of peace.

161.

The Importance of Accuracy in Addition of Money.—In a certain drapery establishment there occurred an apparent mistake in the accounts involving a loss of £3,000. The clerks were set to work to find out the mistake, and after they had expended two whole days in the search, were compelled to give it up. So matters stood. Several days later the office boy decided to keep himself in practice in addition by adding up a column of figures on a sheet which was lying on a desk beside him. Bending his energies to the task, he got along with the units, tens, and hundreds columns, but when he came to the fourth column he could not make it agree with the totals set down. Again and again he tried it, and with the same result—£3,000 less. Going over the figures one by one, his attention was drawn to a fly speck beside a 1 in such a position as to make it appear like a 4, and as such it had been counted by each of the clerks. Thus the mistake was found out, and the boy was promoted.

162.

An Artful Boy.—A lady from the country was once staying at a large West-end hotel. The landlord noticed about nine o'clock every night she would come downstairs, get a jug of hot water, and return to her room. One night he asked her why she did not ring the bell for the hall-boy to bring the water to her. 'There is no bell in my room,' said the lady. 'No bell in your room, madam! Pray let me show you.' And with that he took the jug of water in his hand, and escorted her to her apartment. Entering the room, he pointed out to her the knob of the electric bell. She gazed at it with a sort of horror, and then exclaimed: 'Dear me! Is that a bell? Why, the hall-boy told me that it was the fire-alarm signal, and I must never touch it except in case of fire!' And that is how the hall-boy saved himself trouble.

NEW READING TESTS.—Standard III.

Suitable for 'Unseen Tests' in Dictation also.

133. A sportsman had with him a boy to carry the game-bag. Having missed five partridges in succession, the gunner cried, as he shot at the sixth bird: 'There! I hit him! I saw the feathers fly, didn't they?' 'Yes,' replied the boy dryly—'they *flew*—flew off with the bird!'

134. The chimney swallow, which makes its appearance rather late in the summer, has a long feather on each side of its tail, and as it chooses to build its nest in old chimneys, and makes a great scraping and rubbing with these stiff feathers as it flies up and down to its young ones, it often alarms people terribly; they cannot imagine what the strange rumbling noise is.

135. A lady wishing to give the old women of a parish a treat, took them to the seaside. On arriving there she hired a boat and took them upon the sea. One old woman put her hand over the side and dipped it in the water; she afterwards put her fingers to her lips, and exclaimed in great astonishment, 'Sure, now! no wonder red herrings are salt!'

136. In the spring the Indians of the backwoods of Canada employ themselves in gathering the sweet sap of the maple-tree for the purpose of boiling it down to make sugar. At these times the forest gets quite lively, for then the Indians camp out, and make the woods quite ring with their sounds of industry and mirth.

137. It seems to be the natural habit of sheep to betake themselves to the highest parts of the hill to spend the night. It is generally regarded a sign of the approach of good weather when the flocks set off early to bed. When they linger about late on low land, or do not go to the hill-tops at all at night, unfavourable weather is indicated.

138. A man who became very rich, was very poor when he was a boy. When asked how he got his riches, he replied, 'My father taught me never to play till my work was finished, and never to spend my money till I had earned it. If I had but an hour's work in the day, I must do that the first thing.'

139. The next morning the pastor went about the town to see if he could find out anything about the little stranger. Nobody knew anything except a silly person who lived in a cottage near the wood, and who had been disturbed by the sound of something falling against his door. He was too frightened to go and see what was the matter until the morning. (H.M.I.'s Test.)

140. Speak no ill, but tender be
To other's failings, as your own;
If you're the first a fault to see,
Be not the first to make it known;
For life is but a passing day,
No tongue can tell how brief its span;
Then oh! the little time we stay,
Let's speak of *all* the best we can.

NEW DICTATION TESTS.—Standard IV.

Suitable for 'Unseen Tests' in Reading also.

76.

Seldom do we see in cities, courts, and rich families where men live plentifully, and eat and drink freely, that perfect health, that soundness and vigour of constitution which is commonly seen in the country, in poor houses and cottages, where nature is their cook, and necessity their caterer; and where they have no other doctor but the sun and fresh air.

77.

As a race, negroes do not improve upon acquaintance. Some of the servants have a dog-like fidelity to their masters; but, as in England, the days of attached retainers are dying out, and the new generation is in no way equal to the old. They are lazy, greedy, dishonest, fond of rum, and lack all reasoning power. They dislike regular work, and, having earned a dollar or two, live in the lap of luxury until it becomes necessary to work again.

78.

What is gained by yielding to temper? For a moment there is a feeling of relief; but soon comes a sense of sorrow and shame, with a wish that the temper had been controlled. Friends are separated by a bad temper, trouble is caused by it, and pain is given to others as well as to self. That pain too often lasts for days, even years—sometimes for life. An outburst of temper is like the bursting of a steam boiler; it is impossible to tell before what will be the result.

79.

Sheep are not commonly regarded as useful as beasts of burden, but in a large part of north-western India thousands of sheep carry for many miles the goods that are purchased by the sale of their own wool. The paths among the mountains are so steep that the sheep, more surefooted than larger beasts, are preferred as burden carriers. The load for each sheep is from 16 to 20 lbs.

80.

In India the following practice has been observed in several herds of elephants. The weakly and ailing are carefully attended to by some of their stronger fellows, which, in course of time, become almost well-trained nurses in consequence of the experience thus obtained. They place themselves on each side of the patient, supporting it until it is able to stand alone. Owing largely to the care thus bestowed, the sick elephants frequently recover their wonted health and strength.

81.

The carrier-pigeon, when travelling, never feeds. If the distance be long, it flies on without stopping to take food, and at last arrives thin, exhausted, and almost dying. If corn be presented to it, it refuses to eat, contenting itself with drinking a little water, and then sleeping. Two or three hours later it begins to feed with great moderation, and sleeps again immediately afterwards. If its flight has been very prolonged, it will proceed in this manner for forty-eight hours before recovering its normal mode of feeding.

82.

A postage stamp, equal in value to twopence-halfpenny, is pasted each week in a little blank book which every servant girl in Germany carries. The stamp is the donation of her mistress, enforced by law. Should the girl get sick, the stamps are redeemed by the Government, or she may keep them until she is old, when the Government pays their full value.

83.

If I were a cobbler, I'd make it my pride
The best of all cobblers to be;
If I were a tinker no tinker beside,
Should mend an old kettle like me.
Then whether a tinker or whether a lord,
Whatever my portion may be;
In school I will aim for the top of the class,
In the field for the top of the tree;
Let who will be second, the first I'm determined to be.

STANDARDS V.–VII.

67.

It is the commonest mistake in the world to consider one's self fortunate when things go well—that is, as one would like to have them go; and to consider one's self unfortunate when plans that have been made are broken up, purposes thwarted, and strong desires remain unfulfilled. We are very prone to consider those years prosperous which have brought us ease and comfort and direct results of work; and to consider those years unfortunate which have brought us change, anxiety, and uncertainty. As a matter of fact, as everyone knows who looks back over even a short period of years, this way of judging things from the standpoint of a day is utterly misleading.

68.

The discoveries of science have not only multiplied enjoyments and comforts, but have lengthened time itself, in effect, by promoting economy in its use. The journey which wasted days in a former generation is accomplished in hours now. The telephone and telegraph enable you to transact in a few minutes business which once consumed hours or even days. The difference is so much clear gain. If science has not given greater time to human life, it has in a thousand ways increased the enjoyments and the purchasing power of the time we have, and that comes to the same thing in the end.

69.

There was never, probably, a time in the world's history when high success in any profession demanded harder or more incessant labour than now. Men can no longer go at one leap into eminent position. The world is no longer clay, but rather iron, in the hands of its workers, and men have got to hammer out a place for themselves by steady and rugged blows. Above all, a deep and burning enthusiasm is wanted in everyone who would achieve great ends. No great thing is, or can be, done with-

out it. It is a quality that is seen wherever there are earnest and determined workers—in the silence of the study, and amid the roar of cannon; in the painting of a picture, and in the carving of a statue.

70.

Monkeys when first born are almost as helpless as human infants. Sleeping and looking about and being nursed occupy their first fortnight. The mother is attentive, and at the first sound of danger runs away with her baby in her arms. At the end of the first fortnight, the little one begins to get about by itself, but always under its mother's watchful care. She frequently attempts to teach it to act for itself, and at the earliest intimation of danger, seizes it in her arms and seeks a place of refuge. When about six weeks old the baby begins to need more substantial nutriment than milk, and is taught to provide for himself. Its powers are speedily developed, and in a few weeks its agility is surprising.

71.

The banana is one of the most valuable food products of the earth. No other vegetable compares with it in productiveness, and none other is so rich in pure food constituents. Yet it is in one sense almost a neglected product. They are eaten as fruit more and more every year; but until now hardly anything has been attempted in the way of making a staple meal from them, although banana meal was known long ago. It has been supposed that this meal could not be made in a manner to keep, but recent experiments have proved that it is possible. Several Governments have now become interested in the question, and altogether it is likely that within a few months the manufacture of banana meal will be an established industry in various parts of the world.

72.

The waste of a great city might easily feed its desperate poverty. We waste our coal and our smoke, our gas and our water, our food and our refuse. What we want is more forethought in times of comparative prosperity. The chemist turns scrap iron into ink, old bones into lucifer matches, the shavings of the blacksmith's shop into Prussian blue, the drainings of cow-houses into fashionable perfumery, beggar's rags into new pilot coats, and tar waste into dyes. In Paris they first utilise rats to clear the flesh from the bones of carcases, then kill the rats, use up the fur for trimmings, the skins for gloves, their thigh bones for toothpicks, and their tendons and bones for gelatine wrappers.

73.

As a trifling instance of Mr. Gladstone's curious habits of precision, it may be mentioned that he rarely opens a parcel without untying—not cutting, mind you—the string, tying it carefully up, and putting it away for future use in a drawer which is reserved for the purpose. His papers and documents are also kept in scrupulous order by himself, so that he can lay his hand on any of them at a moment's notice. It is to the habit of doing so much of his work for himself that the mastery of detail which Mr. Gladstone shows on every subject with which he grapples is in a great measure due. (H.M.I.'s Test.)

74.

The noblest men I know on earth
  Are men whose hands are brown with toil;
Who, back'd by no ancestral birth,
  Hew down the woods and till the soil;
And thereby earn a prouder fame
Than follow a king's or warrior's name.
The working men, whate'er their task,
  To carve the stone or bear the hod,
They wear upon their honest brows
  The royal stamp and seal of God;
And brighter are their drops of sweat
Than diamonds in a coronet.

SOME PRACTICAL HINTS ON EAR TRAINING.

By J. A. McGregor,

Music Instructor, Burslem School Board.

The Music requirements relating to Ear Training, as issued by the Education Department, are based upon a practical system, and will appeal to the sympathy and support of every true educationalist. Yet, in many schools the Ear Tests are the least successful part of the Musical curriculum.

From personal observation I trace this solely to bad processes of Training.

"No ear" can only be urged in a small number of cases, and even the majority of these cannot be pronounced as 'incurable.'

I. Let us speak of the Code Division II., viz., Standard I. + II. Here merely the power to imitate a set (3 or 4) of sounds. A good foundation can be laid upon which, in after years, the strongest hold of music may be erected.

The observant teacher will speedily notice how keenly the power to imitate is shown, even among the youngest children. Every gesture is faithfully copied, and the necessity for *good pattern* is proved very early. Let the teacher sternly avoid continual repetition of certain favourite sets of tones.

At once the interest is gone and Ear Training gives place to mere repetition from memory. The teacher must maintain interest by variety and novelty. New plans and methods in the hands of a skilful teacher become a true help to education.

The plan I would recommend here is—

1. Easy progressions of tones, *e.g.*

d	m	r	d	—	s	f	m	s	—	s	l	t	d^1		
f	s	l	s	—	m	s	f	m	—	m	r	d	m		etc.

2. Common 'leaps,' *e.g.*

s	r	f	m	—	s	l	f	s	—	s	r	m	s		
s	d^1	l	s	—	s	l	m	s		etc.					

NEVER SAY 'FAIL.'

Bold, f.
1st & 2nd TREBLES.
BASS.
1. Keep work - ing, 'tis wis - er than sit - ting a - side, And
Key C. Bold, f.
1st & 2nd T.
B.
dream - ing and sigh - ing and wait - ing the tide.
G. t.
dream - ing and sigh - ing and wait - ing the tide.
p
f
In life's ear - ly bat - tle those on - ly pre - vail Who
f. C.
In life's ear - ly bat - tle those on - ly pre - vail Who
fz
ev - er march on - ward and cry 'nev - er fail!'
ev - er march on - ward and cry 'nev - er fail!'

2. With eyes ever open, a tongue that's not dumb,
A heart that will never to sorrow succumb,
You'll battle and conquer though thousands assail,
So onward and upward, and never say 'fail'!

3. In life's rosy morning, in manhood's fair pride,
Let this be your motto your footsteps to guide,
In storm and in sunshine, whatever assail,
Oh! never lose courage, and never say 'fail'!

3. Unusual catches by 'contrasts,' *e.g.*

s r f m — s f r m —
s l f s — s f l s etc.

The teacher should sing all of these to 'laa,' and to avoid a common delusion copy several sets of tones on paper, and thus avoid monotonous and unnecessary repetition.

Often I find a class only able to 'imitate' (?) a set of stock phrases. Check 'leading' scholars. The teacher should attend to mouth opening—seeing in the pupil's facial expression the reflection of his or her own. ('O wad some power the giftie gie us,' etc.) Aim at *perfect* (do not permit partial) imitation: accuracy of tone with exact expression.

II. Code Division III. is often the stumbling block of Ear Training. How often do we hear, 'Only a few of my scholars can name the tones.' Why?

Let us proceed here step by step.

My first rule is: Let the *eye* aid the *ear*.

Place the *1st step* Modulator in view of your class.

'Laa' and *point* while you take a voluntary on the tones of the Doh chord. Make a slip, and you will soon discover how eagerly they can detect errors, remembering, as Disraeli once said, 'It is much easier to be critical than to be correct.'

Now, without pointing, 'laa' a tone, and by pupils' eye following on Modulator, elicit the name of tone.

Eye and Ear Training Combined.

Proceed with this one-tone exercise, always giving Doh chord at first.

Note: d m d' easily named as initial tones. s more difficult.

Next produce the full Modulator. The point is now to obtain evidence of the knowledge of a *rise* or *fall* in a set of three or four tones.

Proceed by 'laaing' a set of three tones (say d' t l) in stepwise succession, and pupils will readily detect a *rise* or *fall*.

To check mere guessing, sing occasionally the same tone three times.

Now return to Modulator, and, by pointing to starting tone, get the names of any succession of three tones, always commencing on a tone of the Doh chord.

With a little practice the pupil will be able, by this method of Ear and Eye Training, to discover readily the initial tone and all succeeding stepwise tones.

Five minutes daily exercise will produce excellent results.

III. The Senior Division of any school trained upon the lines indicated can be taught to fulfil the Code requirements in a few months. Here, also, *daily* exercising is preferable to a long tiring exercise taken once a week.

The Modulator in the early months of the year should be continually before the eye of the class, and the change from stepwise succession to progression by leaps should be gradual.

The tones beyond the Doh chord should be used as initial tones, and the teacher will find it a very useful aid to variety to prepare numerous exercises in the following grades:—

1. Sets commencing on tone of Doh chord, and containing easy leaps, *e.g.*

s r f m d r f m

2. Sets commencing on other tones and easy progressions, *e.g.*

l d' t l — f s r m

3. Difficult sets, *e.g.*

l d' l f — t s r' d'

Always begin by singing d m s d' s m d, this being of vital importance to proper naming, as s fe s may be readily taken for d t, d.

A skilful teacher will mix the various sets, and thus avoid repetition. I have often found classes where s m r d is always the first exercise.

I take it that our object is to raise the *average* of the whole class, and not to display the brilliancy of a few bright shining scholars.

In this connection I now suggest a plan for making the Ear Training *individual* as a means of raising our standard of ability and of investing the lesson with interest.

For many years I have used the 'Sol-fa Rulers' (now supplied by Messrs. J. Curwen & Sons), and have found them a valuable aid in this and kindred work.

While the teacher 'laa's' the exercise, the scholars grasp the ruler in the left hand, and point afterwards, while imitating the teacher, to the sol-fa names with the index finger of the right hand.

The teacher passes rapidly round, and can detect and correct the errors.

There are several advantages I claim for this method:—

1. The test becomes individual. *All* point as all work.
2. The number and variety of exercises becomes doubled by saving time of class without answering.
3. Work is silent.
4. Interest is quickened, and maintained.
5. The bright gifted scholar is not allowed to do all the work. On the other hand, the weaker ones become encouraged and work at the same exercise.
6. The common method is 'examining,' not 'training'; by this, however, training is accompanied by indications of progress.

With these aids to systematic training, towards the end of the school year, I find classes able to do my tests for examination with ease.

The teacher should strongly encourage the elder scholars to follow singers and players at concerts, and endeavour to name the tones as sung or played.

Their interest in Vocal and Instrumental Music will be greatly quickened, and the 'true musical ear,' so rare now, will soon become quite common.

OUR 1894 CERTIFICATE CLASS.

BY DR. GEORGE BEACH, M.A.,

Co-Author of 'A Manual of our Mother Tongue,' 'A Girls' Arithmetic,' Author of 'Elements of English,' 'Entertaining Readers,' 'Historical Readers,' etc.

I. Notes on Latitude and Longitude.

(*a*) Whilst the Equator furnishes a natural division into North and South Latitude, the division into East and West Longitude is merely artificial, neither is it logically acted upon.

In maps of the northern and southern hemispheres the Equator is the southern or northern boundary, but in maps of the eastern and western hemispheres the limiting meridians are not 0° and 180°, but, for purposes of practical convenience, 20° and 160°.

(*b*) It is well known that all the meridians converge at the Poles, and that along the same meridian the same hour of the day is universal.

A few puzzling questions may be asked:—

(α) *When it is noon at Greenwich, what time is it at the Poles?*

Apparently the answer would be '*noon*,' because the Greenwich meridian passes through the Poles.

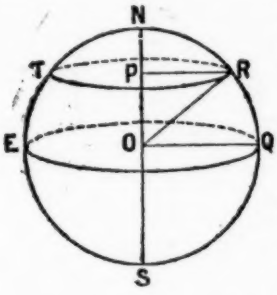
But a difficulty arises. When it is noon at Greenwich it is one o'clock at the Lipari Isles, and two o'clock at St. Petersburg, these places being 15° and 30° E° longitude respectively. Now these meridians also pass through the poles, and therefore, when it is one o'clock at the Lipari Isles, and two o'clock at St. Petersburg, it is also one o'clock and two o'clock at the Poles. Therefore it is *simultaneously* one, two, three, etc., o'clock at the Poles.

(β) By going round the world eastward we gain a day, by going westward we lose a day. Walking eastward round the Pole, (say) at a yard's distance from it, we can easily complete the circuit in 6 seconds and gain a day, and thus easily get 'into the middle of the next six weeks.'

(γ) At the Poles—Which direction is the East, which West?

(*c*) Several of our readers desire to calculate for themselves the length of a degree of longitude at various latitudes. This, of course, varies, as it is $\frac{1}{360}$th of the parallel of latitude, which parallel is a 'small' circle decreasing continually as it nears the Poles, and therefore its $\frac{1}{360}$th part also decreases continually. We shall assume that the earth is a perfect sphere, and also that

a degree of longitude on the Equator measures 69 miles. There will be some error owing to the Earth being an oblate spheroid.



Let SENQ be a complete meridian, EQ be the Equator, TR the parallel of latitude, PR radius circle TR, and OQ radius of circle EQ.

Join OR.

Arc RQ = latitude, ∴ ∧ ROQ = latitude, ∴ ∧ PRO = latitude.

Again, as PR : OQ :: parallel circle TR : equator EQ.

And as TR : EQ :: $\frac{1}{360}$ TR : $\frac{1}{360}$ EQ;

∴ as PR : OQ :: $\frac{1}{360}$ TR : $\frac{1}{360}$ EQ;

but OR = OQ, and $\frac{1}{360}$ of a circle = 1°;

∴ as PR : OR :: 1° of TR : 1° of EQ;

∴ $\frac{PR}{OR} = \frac{1° \text{ of TR}}{1° \text{ of EQ}}$; ∴ 1° of TR = $\frac{PR}{OR} \times$ 1° of EQ;*

but $\frac{PR}{OR}$ = cosine PRO = cosine ROQ = cosine of latitude RQ.

∴ 1° of TR = cosine of latitude × 69 miles.—Q.E.D.

* The reader, innocent of Trigonometry, may, nevertheless solve a few problems by taking the formula at this point.

(*a*) When latitude is 45°, *i.e.* when arc RQ and ∴ ∧ PRO = 45°, $\frac{PR}{OR}$ then = $\frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$;

∴ degree of longitude = $\frac{\sqrt{2}}{2} \times 69$ miles = ·707 × 69 miles = 46·056 miles.

(*β*) When latitude is 60°, then $\frac{PR}{OR} = \frac{1}{2}$;

∴ degree of longitude = $\frac{1}{2} \times 69$ miles = 34·5 miles.

(*γ*) When latitude is 30°, then $\frac{PR}{OR} = \frac{\sqrt{3}}{2}$ = ·866;

∴ degree of longitude = ·866 × 69 miles = 59·754.

II. Official Notes.

(*a*)

'General Post Office, London,
'29th March, 1894.

'Sir,

'With reference to your application of the 26th instant, I beg leave to inform you that Examination Papers with corrections and instructions are transmissible by Book Post, provided that any written or printed matter not forming part of the document itself refer solely to the questions put, or the answers thereto.

'I am, Sir, Your obedient servant,
'S. Walpole, Secretary.

'Dr. G. Beach, M.A.'

(*b*) Copied from 'The Schoolmistress.'

'Education Department,
'20th March, 1894.

'Sir,

'Adverting to your letter of the 15th instant, I am directed to inform you that a candidate who has already passed in the advanced stage of a science subject, without having previously taken the elementary stage of the same, may present herself in May next for Examination in the elementary stage of that subject, and, if successful, receive marks accordingly at the next ensuing Certificate Examination; but she will not obtain marks if she passes again in the advanced stage.

'I have the honour to be, Sir, your obedient servant,
'W. Hodgson.

'H. Barnes, Esq.'

(*c*) Copied from 'School Guardian.'

'Education Department,
'20th March, 1894.

'Rev. Sir,

'Adverting to your letter dated the 7th instant, I am directed to state that second class passes in Drawing Subjects gained in May 1888 are specially allowed to count towards the Elementary Drawing Certificate, and marks are awarded for them in the Certificate Examination.

'I have the honour to be, Rev. Sir,
'Your obedient servant,
'F. C. Hodgson.'

(*d*) Art. 56 of New Code now runs:—

'The (Certificate) Examination will be held on the 10th December, 1894, at each Residential Training College, and at such other times and places as may be necessary. In future years it is intended to hold these examinations in June or July. The subjects of examination are different for men and women, and for first, second, and third years. A syllabus may be had on application to the Secretary, Education Department, Whitehall, London, S.W.'

(*e*) Article 59 of New Code reads:—

'The names of all candidates for the (Certificate) Examination in 1894, not being students in any Training College, must be notified to the Department before the 1st October, and for the examination in 1895 before the 1st May.

'N.B.—It will be necessary in future to enforce this "Article" strictly.'

III. Mathematical Solutions.

(*a*) A father divided £210 among his three children in geometrical progression; the first had £90 more than the last. How much had each?

Let xy^2, xy, x = No. of £ each had.

I. Then $xy^2 = x + 90$,

and $x + xy + xy^2 = 210$;

$\therefore 2x + xy + 90 = 210$.

II. $2x + xy = 120$.

Now from equation I., $x = \frac{90}{y^2 - 1}$.

" " II., $x = \frac{120}{y + 2}$.

$\therefore \frac{120}{y+2} = \frac{90}{y^2-1}$;

or $4y^2 - 3y - 10 = 0$.

$\therefore y = 2$, or $-\frac{5}{4}$.

$x = 30$ or 160.

Answers £120, £60, £30.

(*b*) The sum of three numbers in geometrical progression is 35, and the mean term is to the difference of the extremes as 2 : 3. Required the numbers.

Let $\frac{x}{y}$, x, xy be the three nos.

I. Then $\frac{x}{y} + x + xy = 35$,

and $x : xy - \frac{x}{y} :: 2 : 3$,

or $1 : y - \frac{1}{y} :: 2 : 3$;

$\therefore 2y - \frac{2}{y} = 3$.

$y^2 - \frac{3}{2}y - 1 = 0$.

$y = 2$ or $-\frac{1}{2}$.

Now $-\frac{1}{2}$ does not satisfy the conditions;

$\therefore \left(\frac{x}{2} + x + 2x\right) = \frac{7x}{2} = 35$. From I.

$\therefore x = 10$.

Answers 5, 10, 20.

(*c*) There are three numbers in geometrical progression, the greatest of which exceeds the least by 15. Also the difference of the squares of the greatest and least is to the sum of the squares of all the three numbers as 5 : 7. Required the numbers.

Let x, xy, xy^2 be the numbers.

I. Then $xy^2 - x = 15$.

$x^2y^4 - x^2 : x^2y^4 + x^2y^2 + x^2 :: 5 : 7$,

or $y^4 - 1 : y^4 + y^2 + 1 :: 5 : 7$.

By convertendo $\therefore y^4 - 1 : y^2 + 2 :: 5 : 2$;

$\therefore y^4 - 1 = \frac{5y^2}{2} + 5$;

$\therefore y^4 - \frac{5}{2}y^2 - 6 = 0$;

$\therefore y^2 = 4$ or $-\frac{3}{2}$.

The latter value is impossible ; $\therefore y = \pm 2$.

$\therefore$ From I. $(4x - x) = 3x = 15$.

$\therefore x = 5$.

Answers 5, 10, 20.

(*d*) The square of any number together with the number itself, is always divisible by 2.

Let x = any number ;

then $x^2 + x$ must be divisible by 2,

for $x^2 + x = x(x + 1)$.

Now if x be odd, then $x + 1$ is even, and therefore one of these factors must always be divisible by 2.

(*e*) *Corollary from* (*d*). The square of any odd number diminished by 1 is divisible by 8.

Let the odd number $= 2x + 1$,

and its square $= 4x^2 + 4x + 1$;

then $4x^2 + 4x$ must be divisible by 8,

for $4x^2 + 4x = 4(x^2 + x)$.

But by (*d*) $x^2 + x$ is divisible by 2;

$\therefore 4(x^2 + x)$,, ,, 8.—Q.E.D.

IV. Model Answers to 1893.

ALGEBRA AND MENSURATION.

First Year.—Men.

1. Resolve the following expressions into factors :—

(*a*) $85x^2 - xy - 14y^2$; (*b*) $(5a + 3b + c)^3 - (5a - 3b - c)^3$;

(*c*) $a^2x + b^2y + ab(x + y)$;

and simplify

$$\frac{(a^3 + b^3)(a^2 + b^2)^2}{a^4 - b^4} \div \left(a + b - \frac{3ab}{a + b}\right).$$

(*a*) $85x^2 - xy - 14y^2 = (5x + 2y)(17x - 7y)$.—Q.E.F.

(*b*) $(5a + 3b + c)^3 - (5a - 3b - c)^3$

$= (5a + 3b + c - 5a + 3b + c)\{(5a + 3b + c)^2$

$+ (5a + 3b + c)(5a - 3b - c) + (5a - 3b - c)^2\}$

$= 2(3b + c)(125a^2 + 9b^2 + 6bc + c^2)$.—Q.E.F.

(*c*) $\dfrac{(a^3 + b^3)(a^2 + b^2)^2}{a^4 - b^4} \div \left(a + b - \dfrac{3ab}{a + b}\right)$.

$= \dfrac{(a^2 - ab + b^2)(a + b)(a^2 + b^2)^2}{(a^2 + b^2)(a + b)(a - b)} \times \dfrac{a + b}{a^2 - ab + b^2}$

$= \dfrac{(a + b)(a^2 + b^2)^2}{a - b}$.—Q.E.F.

2. (*a*) Prove the rule for finding the Lowest Common Multiple of any two algebraical expressions.

(*b*) Find the Highest Common Factor of

$51(2a^4 + 9a^3 + 14a + 3)$ and $68(3a^5 + 14a^4 + 9a^2 + 2a)$.

(*a*) Let A and B be two expressions.

Required to prove that the L.C.M. of A and $B = AB \div$ their G.C.M.

Let $A = mD$. $B = nD$. D being their C.G.M.

$\therefore m$ and n have no common factor.

$\therefore$ L.C.M of A and $B = mnD$.

$$\frac{AB}{D} = \frac{mnD^2}{D} = mnD = \text{L.C.M of } A \text{ and } B.\text{—Q.E.D.}$$

(*b*)

$2a$	$2a^4 + 9a^3 + 14a + 3$		a	$3a^5 + 14a^4 + 9a^2 + 2a$	
	$2a^4 - 48a^2 - 10a$			$3a^4 + 14a^3 + 9a + 2$	
9	$9a^3 + 48a^2 + 24a + 3$			2	
	$9a^3 - 216a - 45$				
	$48 \mid 48a^2 + 240a + 48$			$6a^4 + 28a^3 + 18a + 4$	3
		$a^2 + 5a + 1$		$6a^4 + 27a^3 + 42a + 9$	
				$a^3 - 24a - 5$	a
				$a^3 + 5a^2 + a$	
				$-5a^2 - 25a - 5$	-5
				$-5a^2 - 25a - 5$	
				. . .	

G.C.M. of $(2a^4 + 9a^3 + 14a + 3)$ and $(3a^5 + 14a^4 + 9a^2 + 2a)$

$= a^2 + 5a + 1$.

$51 = 3 \times 17$; $68 = 4 \times 17$; $\therefore$ G.C.M. of 51 and 68 $= 17$.

$\therefore$ G.C.M. required $= 17(a^2 + 5a + 1)$.

3. (*a*) Assuming that for all values of m and n, $a^m \times a^n = a^{m+n}$, find the meaning of $a^{\frac{1}{n}}$.

(*b*) Divide $a^{\frac{4}{3}} + a^{\frac{3}{3}}b + b^2$ by $a^{\frac{2}{3}} + a^{\frac{1}{3}}b^{\frac{1}{2}} + b$.

(*a*) Since $a^m \times a^n = a^{m+n}$,

$\therefore a^{\frac{1}{n}} \times a^{\frac{1}{n}} \times a^{\frac{1}{n}} \ldots$ to n factors $= a^{\frac{1}{n} + \frac{1}{n} + \frac{1}{n}} \ldots$ to n factors

$= a$.

By taking the nth root of each side we get

$$\sqrt[n]{a^{\frac{1}{n}} \times a^{\frac{1}{n}} \ldots \text{ to } n \text{ factors}} = \sqrt[n]{a}$$

$$\therefore a^{\frac{1}{n}} = \sqrt[n]{a},$$

that is, $a^{\frac{1}{n}}$ means the nth root of a.

(*b*) $\dfrac{a^{\frac{4}{3}} + a^{\frac{3}{3}}b + b^2}{a^{\frac{2}{3}} + a^{\frac{1}{3}}b^{\frac{1}{2}} + b} = \dfrac{(a^{\frac{2}{3}} - a^{\frac{1}{3}}b^{\frac{1}{2}} + b)(a^{\frac{2}{3}} + a^{\frac{1}{3}}b^{\frac{1}{2}} + b)}{a^{\frac{2}{3}} + a^{\frac{1}{3}}b^{\frac{1}{2}} + b}$

$= a^{\frac{2}{3}} - a^{\frac{1}{3}}b^{\frac{1}{2}} + b$.—Q.E.F.

4. Solve the equations :—

(1) $\dfrac{x + 16}{36} - \dfrac{13x - 2}{17x - 32} = \dfrac{x}{4} - \dfrac{2x + 8\frac{1}{2}}{9}$;

(2) $\begin{cases} x + \dfrac{x - 3}{y - 18} = 30 + \dfrac{3x - 73}{3}, \\ y - \dfrac{2x - y}{23 - y} = 20 + \dfrac{2y - 59}{2} ; \end{cases}$

(3) $\dfrac{x + 2}{x - 1} - \dfrac{14 + x}{7x} = 1\frac{29}{42}$.

(1) $\dfrac{x + 16}{36} - \dfrac{13x - 2}{17x - 32} = \dfrac{x}{4} - \dfrac{2x + 8\frac{1}{2}}{9}$

$= \dfrac{x + 16}{36} - \dfrac{13x - 2}{17x - 32} = \dfrac{x}{4} - \dfrac{4x + 17}{18}$.

Multiply by $36(17x - 32)$,

then $(x - 16)(17x - 32) - 136(13x - 2)$

$= 9x(17x - 32) - 2(17x - 32)(4x + 17)$.

Expanding :

$\therefore 17x^2 + 240x - 512 - 468x + 72$

$= 153x^2 - 288x - 136x^2 - 322x + 1088$.

Collecting :

$\therefore 382x = 1528$,

$x = 4$. Ans.

(2) $\begin{cases} x + \dfrac{x - 3}{y - 18} = 30 + \dfrac{3x - 73}{3} & (a) \\ y - \dfrac{2x - y}{23 - y} = 20 + \dfrac{2y - 59}{2} & (b) \end{cases}$

Multiply (*a*) by $(y - 18)$ 3, and we get

$3xy - 54x + 3x - 9 = 90y - 1620 + 3xy - 73y - 54x + 1314$,

$\therefore 3x - 17y = -297$. (*c*)

Multiply (*b*) by $(23 - y)$ 2, and we get

$46y - 2y^2 - 4x + 2y = 920 - 40y + 46y - 1357 - 2y^2 + 59y$,

$\therefore -4x - 17y = -437$. (*d*)

Subtract (*d*) from (*c*), and we get

$7x = 140$, $\therefore x = 20$.

Substitute in (*c*)

$\therefore 60 - 17y = -297$.

$\therefore 17y = 357$, $\therefore y = 21$.

} Ans.

(3) $\dfrac{x + 2}{x - 1} - \dfrac{14 + x}{7x} = 1\frac{29}{42}$.

Multiply by $42x(x - 1)$,

then $42x(x + 2) - 6(x - 1)(14 + x) = 71(x - 1)x$.

Expanding :

$\therefore 42x^2 + 84x - 84x - 6x^2 + 84 + 6x = 71x^2 - 71x$,

$\therefore -35x^2 + 77x + 84 = 0$.

Divide by (-7) :

$\therefore 5x^2 - 11x - 12 = 0$.

$\therefore (x - 3)(5x + 4) = 0$,

$\therefore x = 3$, or $-\frac{4}{5}$. Ans.

5. A man can walk forwards four times as fast as he can backwards, and undertakes to walk a certain distance (a quarter of it backwards) in a certain time. But the ground being bad, he finds that his rate per hour backwards is one-fifth of a mile less than he had reckoned, and that to accomplish his undertaking he must walk forwards two miles an hour faster. What is his rate per hour backwards?

Let x = rate per hour backwards in miles,
then $4x$ = rate per hour forwards in miles,
$(x - \frac{1}{5})$ = rate per hour backwards owing to bad ground,
$(4x + 2)$ = increased rate per hour forward.

By question :

$$\frac{1}{4x} + \frac{3}{16x} = \text{time taken to walk the distance,}$$

$$\text{also } \frac{1}{4(x-\frac{1}{5})} + \frac{3}{4(4x+2)} = \text{time taken to walk the distance ;}$$

$$\therefore \frac{1}{4x} + \frac{3}{16x} = \frac{1}{4(x-\frac{1}{5})} + \frac{3}{4(4x+2)}.$$

Dividing by $(\frac{1}{4})$, etc. :

$$\therefore \frac{1}{x} + \frac{3}{4x} = \frac{5}{5x-1} + \frac{3}{4x+2};$$

$$\therefore \frac{7}{4x} = \frac{35x+7}{(5x-1)(4x+2)};$$

$$\therefore \frac{1}{4x} = \frac{5x+1}{(5x-1)(4x+2)}.$$

Multiply across :

$$\therefore 20x^2 + 6x - 2 = 20x^2 + 4x;$$

$$\therefore 2x = 2,$$

$$x = 1;$$

$\therefore$ Rate per hour backwards = 1 mile. Ans.

6. (*a*) Prove that a quadratic equation cannot have more than two roots.

(*b*) If p, q are the roots of $mx^2 + nx + r = 0$, find the equation whose roots are pq and $\frac{1}{pq}$.

(*a*) If possible in the equation $x^2 + px + q = 0$, let x have three different roots, m, n, r ;

then by supposition $m^2 + mp + q = 0$; (1)

$$n^2 + np + q = 0 ; \quad (2)$$

$$r^2 + rp + q = 0 ; \quad (3)$$

Subtracting (2) from (1), we get $(m^2 - n^2) + (m - n)p = 0$.
Dividing by $(m - n)$, which by supposition is not zero,

$$\therefore (m + n) + p = 0. \quad (4)$$

Subtracting (3) from (1), we get $(m^2 - r^2) + (m - r)p = 0$.
Dividing by $(m - r)$, which by supposition is not zero,

$$\therefore (m + r) + p = 0. \quad (5)$$

Subtracting (5) from (4), we get $(n - r) = 0$.
But n and r are different roots, and
$\therefore (n - r)$ cannot be zero.
Hence a quadratic cannot have three roots.—Q. E. D.

(*b*) $mx^2 + nx + r = 0$.

$$\therefore x^2 + \frac{n}{m}x + \frac{r}{m} = 0.$$

Since p and q are the roots of this equation, $pr = \frac{r}{m}$.

(Theory of quadratics.)

$$\text{Required equation} = \left(x - pq\right)\left(x - \frac{1}{pq}\right) = 0,$$

$$\text{which } \left(x - \frac{r}{m}\right)\left(x - \frac{m}{r}\right) = 0 ;$$

$$\therefore x^2 - \left(\frac{r}{m} + \frac{m}{r}\right)x + 1 = 0.$$

$$\therefore mrx^2 - (r^2 + m^2)x + mr = 0. \quad \text{Ans.}$$

7. (*a*) Show that a ratio which is greater than unity is diminished by adding the same quantity to both terms of the ratio.

(*b*) If x is a mean proportional between m and n, then

$$\frac{1}{m^2 - x^2} + \frac{1}{n^2 - x^2} + \frac{1}{x^2} = 0.$$

(*a*) Let $\frac{a}{b}$ be a ratio of greater inequality.

Add x to each term ;

$$\therefore \frac{a}{b} - \frac{a+x}{b+x} = \frac{x(a-b)}{b(b+x)}.$$

But $a > b$ (hyp.), $\therefore (a - b)$ is positive ;

$\therefore \frac{x(a-b)}{b(b+x)}$ and $\frac{a}{b} - \frac{a+x}{b+x}$ are positive ;

$\therefore \frac{a}{b}$ is $>$ than $\frac{a+x}{b+x}$, $\therefore$ a ratio, etc.—Q. E. D.

(*b*) Given $x^2 = mn$.

$$\text{Prove } \frac{1}{m^2 - x^2} + \frac{1}{n^2 - x^2} + \frac{1}{x^2} = 0.$$

Substitute value of x^2 :

$$\therefore \frac{1}{m(m-n)} + \frac{1}{n(n-m)} + \frac{1}{mn} = \frac{1}{m(m-n)} - \frac{1}{n(m-n)} + \frac{1}{mn}$$

$$= \frac{n - m + m - n}{mn(m-n)} = 0.\text{—Q. E. D.}$$

8. (*a*) When is one quantity said to vary directly as a second, and inversely as a third?

(*b*) Two solid globes of gold whose radii are r, r', are melted and formed into a single globe ; find its radius, having given that the volume of a globe varies as the cube of its radius.

(*a*) A is said to vary directly as B, and inversely as C, when A varies as $\frac{B}{C}$.

(*b*) Let v and v_1 be the volumes of the globes whose radii are r and r_1 ;

And let V be the volume of the largest globe, and R the required radius.

Then since the volumes $\propto$ the cube of the radii,

$$\therefore v = mr^3,\ v_1 = mr_1^3,\ V = mR^3.$$

But $V = v + v_1$;

$$\therefore mR^3 = mr^3 + mr_1^3,$$

or $R^3 = r^3 + r_1^3$;

$$\therefore R = \sqrt[3]{r^3 + r_1^3}. \quad \text{Ans.}$$

9. (*a*) Find the sum of n terms of an arithmetical progression whose first term is a, and the common difference is d.

(*b*) Determine the relation between a, b, c, p, q, r, so that a, b, c may be respectively the pth, qth, and rth terms of an arithmetical progression.

(*a*) Let a = first term; d = common difference; n = number of terms.

Also let l = last term. S = required sum ; then

$$S = a + (a + d) + (a + 2d) + \ldots + (l - 2d) + (l - d) + l ;$$

and by writing the series in the reverse order,

$$S = l + (l - d) + (l - 2d) + \ldots + (a + 2d) + (a + d) + a.$$

Adding together these two series,

$$2S = (a + l) + (a + l) + (a + l) + \ldots \text{ to } n \text{ terms}$$

$$= n(a + l) ;$$

$$\therefore S = \frac{n}{2}(a + l),$$

and $l = a + (n - 1)d$;

$$\therefore S = \frac{n}{2}\{2a + (n - 1)d\}.\text{—Q. E. F.}$$

(*b*) Let A = first term ; d = common difference.

$$a = A + (p - 1)d,$$

$$b = A + (q - 1)d,$$

$$c = A + (r - 1)d ;$$

$$(a - b) = (p - q),$$

$$b - c = q - r,$$

$$c - a = r - p ;$$

whence

$$a - b : b - c : c - a :: p - q : q - r : r - p. \quad \text{Ans.}$$

10. (*a*) Insert n geometric means between a and b.

(*b*) The sum of an infinite geometric series is 3, and the sum of its first two terms is $2\frac{2}{3}$; show that there are two such series, and find them.

(*a*) Let a and b be the given quantities, n the number of terms.

In all there will be $(n+2)$ terms.
Let r be the common ratio.

$$b = \text{the } (n+2)^{\text{th}} \text{ term} = ar^{n+1};$$

$$\therefore r^{n+1} = \frac{b}{a};$$

$$\therefore r = \left(\frac{b}{a}\right)^{\frac{1}{n+1}} \quad (1)$$

Hence the required means are ar, ar^2,.....ar^n, where r has the value found in (1);

that is, $a\left(\frac{b}{a}\right)^{\frac{1}{n+1}}$; $a\left(\frac{b}{a}\right)^{\frac{2}{n+1}}$ ..... $a\left(\frac{b}{a}\right)^{\frac{n}{n+1}}$.—Q.E.F.

(*b*) Let a be the first term; r = common ratio.
By question:

$$\frac{a}{1-r} = 3; \ (1) \quad \therefore a = 3(1-r)$$

$$a + ar = \frac{8}{3}; \ (2)$$

$$\therefore 3a(1+r) = 8.$$

Substitute value of a:

$$\therefore 9(1-r^2) = 8.$$

$$\therefore r^2 = \frac{1}{9};$$

$$\therefore r = \pm \frac{1}{3}.$$

Substitute first value of r in (1):

$$\therefore \frac{a}{1-\frac{1}{3}} = 3; \ \therefore \frac{3a}{2} = 3; \ \therefore a = 2.$$

Substitute second value of r in (1).

$$\therefore \frac{a}{1+\frac{1}{3}} = 3; \ \therefore \frac{3a}{4} = 3; \ \therefore a = 4.$$

The series are:

(1) 2, $\frac{2}{3}$, $\frac{2}{9}$, $\frac{2}{27}$
(2) 4, $-\frac{4}{3}$, $\frac{4}{9}$, $-\frac{4}{27}$ } Ans.

MENSURATION. $\left(\pi = \frac{22}{7}\right)$

1. Find in yards, to four places of decimals, the difference between the area of a regular hexagon, each of whose sides is 72 yards, and the area of the circle inscribed in it.

1. Area of hexagon = sq. on half side $\times \sqrt{3} \times 6$
$= 36^2 \times \sqrt{3} \times 6.$

Radius of inscribed $\odot = \sqrt{72^2 - 36^2} = \sqrt{108 \times 36} = 36\sqrt{3}.$

Area of inscribed $\odot = \pi r^2 = \frac{22}{7} \times 36^2 \times 3.$

Area of hexagon — Area of inscribed $\odot$

$$= 36^2 \times 6 \times \sqrt{3} - \frac{22}{7} \times 36^2 \times 3$$

$$= 36^2 \times 6\left(\sqrt{3} - \frac{11}{7}\right) = 7776(1{\cdot}732 - 1{\cdot}5714)$$

$$= 7776 \times {\cdot}1606$$

$$= \underline{1248{\cdot}8256 \text{ sq. yds.}} \quad \text{Ans.}$$

2. Find, to three places of decimals, the radius of the circle whose area is the sum of the areas of the two triangles whose sides are 35, 53, 66, and 33, 56, 65.

2. Let a, b, c = sides of first $\triangle$, and

$$S = \frac{a+b+c}{2} = \frac{35+53+66}{2} = 77.$$

Let a', b', c' = sides of second $\triangle$, and

$$S' = \frac{a'+b'+c'}{2} = \frac{33+56+65}{2} = 77.$$

Area of first $\triangle$

$$= \sqrt{S(s-a)(s-b)(s-c)} = \sqrt{77 \cdot 42 \cdot 24 \cdot 11}$$

$$= \sqrt{7^2 \times 11^2 \times 6^2 \times 2^2} = 11 \times 7 \times 6 \times 2 = 924.$$

Area of second $\triangle$

$$= \sqrt{S'(s'-a')(s'-b')(s'-c')} = \sqrt{77 \cdot 44 \cdot 21 \cdot 12}$$

$$= \sqrt{11^2 \times 7^2 \times 2^2 \times 3^2 \times 2^2} = 7 \times 11 \times 2 \times 3 \times 2 = 924.$$

Area of $\odot = \pi r^2 = 2 \times 924 = 1848;$

$$\therefore \frac{22}{7} r^2 = 1848 = 84 \times 22;$$

$$\therefore r^2 = 588;$$

$$\therefore \underline{r = 24{\cdot}248}\ldots\ldots\text{Ans.}$$

V. Model Answers to 1893.

DOMESTIC ECONOMY.

Women—First Year.

1. Discuss the reasons for and against an exclusively vegetable diet.

(*a*) *The reasons for a vegetable diet are:*—
(1) Plants are very rich in all the necessary food substances.
(2) Nearly all the carbo-hydrates are obtained from vegetable sources.
(3) There are vegetable proteids and fats; vegetables are said to contain an even larger percentage of proteid matter than do animal foods.
(4) Vegetable foods are much cheaper than animal foods.
(*b*) *The reasons against a vegetable diet are:*—
(1) The vegetable proteids are not so nutritive as those of flesh.
(2) The nutritive materials are in some cases in so condensed a form as to be difficult of digestion.
(3) Vegetables contain an excess of carbonaceous matters.
(4) The bodily structure of man, the formation of his stomach, and length of intestines (which are alike intermediate between those of purely carnivorous and herbivorous animals) are all opposed to the idea of his being a vegetable feeder, but point to the fact that a judiciously mixed diet of animal and vegetable foods is the most suitable.

2. What is the use of the mastication of food? Describe the process, and the organs concerned in it. What kinds of food are not affected by saliva?

(*a*) Mastication is the preparation of food which takes place in the mouth before it is passed on to the stomach.
(*b*) The food is crushed and ground by the teeth; three pairs of salivary glands pour upon the food the saliva, which moistens and softens, thus assisting the crushing and grinding, and thus the food undergoes mastication; it is then ready to be passed to the digestive organs.
(*c*) Proteids and fats are not affected by the saliva.

3. Say what are the principal constituents, respectively, of meat, peas, potatoes, fish, and what is the nutritive value of each. Are green vegetables digestible?

Meat contains fibrin, albumen, and gelatine, also about four-fifths water and a proportion of fat.
Meat is at the head of articles of food as supplying the largest amount of strength in the smallest compass.
Peas contain a large proportion of a flesh-forming substance called legumen; also starch, water, cellulose, and a small amount of fat and mineral matter.
Green peas are exceedingly nutritious and wholesome, and when dried peas are used for soup, the addition of animal food is scarcely required.
Potatoes contain three-fourths of their weight water. The solid matter remaining is principally starch, consequently the nutritious qualities are very small, and alone they are not well calculated to support life; but the saline substances contained render potatoes a powerful antiscorbutic.
Fish contains the same flesh-forming materials as meat, but not in such large quantities. It is not so nutritious, but is less stimulating, more easily digested, and accordingly valuable for sick people. Fish also contains very valuable nerve and brain-forming substances.
The digestibility of green vegetables depends much upon the cooking. Peas and beans require great attention because of the skins; otherwise green vegetables, especially for hard workers, are valuable and easily digested.

4. Explain the words gastric juice, bile, capillaries, pulmonary, nitrogen.

(1) When food enters the stomach, the mucous membrane, previously pale, turns pink owing to the dilation of the blood-vessels. At the same time the gastric glands secrete a colourless fluid with an acid reaction called the *gastric juice*. This juice is composed of hydrochloric acid and pepsin. While the glands are secreting, the walls of the stomach by their contraction are subjecting the food to certain movements, whereby the food and gastric juice become intimately mixed. Its action upon the food (or a large proportion of it) is to render it more liquid, and is the second stage in the process of digestion.
(2) Bile is a secretion of the liver. It is a yellow alkaline fluid containing about 9 per cent. of *bile-salts*, which aid in the emulsification of fat, and therefore in its absorption.
(3) *The Capillaries* are minute tubes with very thin walls distributed through the whole organism of the human body,

except the epidermis and its products, the epithelium, the cartilages, and the teeth. On all sides these tubes pass into others which are called arteries and veins.

(4) Pulmonary, appertaining to the lungs, from L. *pulmones* = lungs (akin to Gr. πλευμων for πνευμων = breather).

(5) Nitrogen is a gas without colour, odour, or taste; it neither burns nor supports combustion, and therefore cannot support life. It forms about four-fifths of the air which surrounds us, and it occurs in combination in coal and in some other minerals, and in all plants and animals. Foods containing nitrogen (nitrogenous foods) are the only foods that are able to build up lean flesh, muscles, and sinews of the body, and so convey to it real nourishment.

5. In what part of the body is the liver? Describe its functions.

The liver is the largest glandular organ in the body. It lies on the right side of the body immediately below the diaphragm, with which its upper surface is in contact, while its lower surface touches the intestines and the right kidney. It is invested by a coat of peritoneum which keeps it in place. The liver separates a peculiar fluid, *the bile*, from the blood, and throws that fluid into the intestines. It also elaborates a substance, *glycogen*, which is capable of passing very readily into a kind of sugar called *glucose*, and is carried off in one shape or another by the blood. It is also very probable that the liver is one source of the colourless corpuscles of the blood.

6. Discuss the respective merits of getting expensive materials that last a long time for clothing, or cheaper ones that do not last so well.

Really expensive materials may mean luxurious clothing, but it is most certainly better to give a reasonable price for the articles we wear, and so ensure, to some extent at least, their durability, than to pay such a sum as will render it impossible for the things to do us service.

Cheap clothing may be composed of poor, mixed materials, which will not wash or clean, are full of 'dress' to make them look well, and this will leave them very soon, so that they look shabby; in the case of boots, gloves, jackets, and other ready-made articles, the workmanship is poor, the articles are poorly lined, trimmed, and bad fitting; re-making of garments is out of the question, because the materials do not wear equally, and colours fade.

Better clothing at a reasonable price will be the opposite of the above, and in the end save more than the extra money given. Especially should underlinen, flannels, and boots be of very good quality, for warmth and wear. Children's clothing perhaps may be made of rather less expensive materials, because of their rapid growth.

7. Give short notes of a lesson on starch, both as an element of food and as a material used in washing.

I. *Introduction*—

Take first, starch as used in washing, it being most familiar in that form. Show some, and ask what is its use. (*To stiffen.*) Name some things 'got up' with starch. Ask a few questions about the preparation of *cold* and *hot* starch, and be prepared to make some in front of the class.

II. *General description and properties*—

Crush a little in the hand—(a powder)—colour—(white)—texture—(fine)—tasteless. Refer to starch-making; cold water did not dissolve, hot water did, and forms on cooling *a paste.* When cold starch is used we do not dry the articles, but at once apply the hot iron, which makes them very stiff, the hot iron swelling the grains instead of the water doing so.

III. *How obtained*—

Some girls will have seen their mothers use *flour* starch. Make a little. Cornflour when covered with boiling water becomes the same kind of mass. Put a little rice in water. Show starch floating on top. Explain that this loose starch if cooked would swell, and cause the grains of rice to stick together and spoil it. The rubbing together of rice grains has loosened this starch. Have a potato pulped and washed, and the sediment dried, or explain the process. The girls should now be able to tell where starch is obtained from, and the general method of obtaining it. From wheat, rice, corn, potatoes, &c.

IV. By inference now we have found that *much starch is contained in our food.* Tell that an excess is injurious because it gives warmth only and not nourishment. Ask what is usually taken with rice—milk, meat with potatoes, all things with bread, &c.

Put a little starch into the mouth, hold it a little while, and arrive at the result, viz., that the starch becomes *sweet.* The saliva in the mouth can turn starch to sugar, which is more digestible.

Because starch gives warmth, we call it a warmth producer, and it is placed among the Carbonaceous Foods.

8. Name any ordinary conditions which produce an excess of carbonic acid in the air of a room. What proportion of it in the air makes a room close and unpleasant?

Carbonic acid is produced by burning and breathing. The oxygen of the air unites with the carbon during combustion and breathing, producing the compound carbonic acid gas.

If this gas is not properly liberated it will be breathed again and again, increase in quantity, and become poisonous by means of its excess.

1. In small rooms containing large families, and in large rooms overcrowded, the supply of oxygen is not sufficient for the demand, and this will result in accumulation of carbonic acid.

2. In rooms which are lit up with gas or lamps, the same thing occurs, because the ventilation, especially in the evenings (when most apertures are closed), is not sufficient to compete with the demand on the oxygen required to support the combustion. Air containing four per cent., or even less, is very injurious. A greater amount is rapidly destructive to life; 0·2 or 0·3 per cent. will make a room very unpleasant.

9. Describe a paraffin lamp. What are the points you would be careful to secure when buying one?

A paraffin lamp contains a vessel for holding the petroleum or paraffin oil; a wick (sometimes more than one) made of cotton; and a glass chimney to prevent the air getting to the flame. The wick is placed in a slit and worked up and down by a spindle, and round the wick is a perforated plate so that sufficient air may reach it to enable the flame to burn. Paraffin lamps may be procured of many kinds; hanging lamps, chandelier fitted lamps, brackets, and small lamps for night-lights or carrying about. In purchasing these the following care should be exercised:—

1. If to stand on the table, see the lamp is well weighted, have a fire-proof chimney, and a glass vessel to hold the oil. This last because, although perhaps more fragile, it is easy to see when the oil wants replenishing, and there is danger of the vessel getting empty and an explosion taking place.

2. Take care to get the newest improvements, (*a*) a patent extinguisher, so that you may know when the lamp is out; (*b*) a lamp that has a contrivance for immediately putting out the light in the event of an accident.

3. Choose a lamp which has a separate aperture for filling.

10. Explain carefully the points to be observed in washing flannel articles.

The chief points to be observed in washing flannel articles are:—

1. As much loose dirt as possible must be shaken from them before putting into water.

2. The water used must not be of extreme temperature, but rather more than luke-warm, and all waters used must be of the same heat.

3. The articles must not wait in the water, but should be taken through all waters one at a time and be hung out at once.

4. No soap must be rubbed upon them, but a lather must be made and the articles kneaded and squeezed in it.

5. Care must be taken to rinse well, to remove all soap.

6. They should be dried in the open air, and while drying they should be constantly pulled and stretched to prevent shrinking.

11. How are houses supplied with water? In choosing a house what points would you attend to in order to secure the purity and wholesomeness of the water?

Houses are supplied with water—(1) from springs and wells; (2) by means of taps, conducting water through the street main from reservoirs; (3) by rain stored in cisterns or tanks.

1. In order that water may be wholesome it is necessary that springs and wells should be built round with bricks or cement, so that sewage matter may not enter; also they should be covered in to keep out dust, but not sufficiently to exclude air. Deep wells are best.

2. In the case of tap water, the constant supply system secures fresh water, and is therefore better than having the water resting for any length of time in a cistern.

3. Rain water should be collected in cisterns made of slate, flat stones, bricks or tiles set in Roman cement. Never allow water to remain in lead cisterns or tanks.

12. Write notes for a practical lesson to a first class of girls on the repairing of old garments, table-cloths, or sheets, showing how you would deal with common cases of accident or wear.

Lesson on Repairing Linen.

1. Show and describe different kinds of repairing required. (*a*) Thin places; (*b*) Holes; (*c*) Cuts; (*d*) Tears.

2. Method of repairing each (theory and demonstration only).

(*a*) *Thin places.*—These should be darned. Cotton, linen, thread, &c., must match material in colour. Must not be *thicker* than material, or would be bulky; must not be finer, or would not wear. Generally darn is on wrong side, loops would be unsightly on right. Sheets get thin in centre because most worn. A good way is to cut down centre and turn sides to middle.

(*b*) *Holes.*—These must be patched. The patch is put upon the right side. Underlinen, tablecloths, sheets, &c., are best patched with partly worn calico—sometimes two old garments will make nicely into one in this way. The patch must be felled on the under side to prevent rubbing the skin. Print is patched on right side.

Match pattern carefully. Under-side need not be felled, only made neat. Show diagram and explain blanket stitch. Flannel is patched on wrong side and herring-bone stitch only used.

(*c*) *Cuts.*—Tablecloths are most likely to get cut—the cut is nearly always a slanting one, and so is called a *diagonal cut*. A diagram of the working of this should be shown, and the method demonstrated by drawing.

(*d*) *Tears.*—Dresses catch on nails; linen gets torn in the wash and on the line. The hedge tear or corner tear is most common. This is darned in squares overlapping each other.

For all these, a demonstration frame and drawing on the blackboard should be used, also worked specimens should be shown. The real working of each will require a separate practical lesson.

VI. We have made arrangements, merely to suit our own Readers, and with no desire to interfere with existing agencies, for *tuition* (based upon these articles, routines and questions) by experienced Teachers and Graduates. Names of intending Pupils should be sent direct to Dr. G. BEACH, M.A., *Stanley Mount, Macclesfield*. The fees, *to be paid in advance*, are 1s. 6d. per paper, 2s. 9d. per month, 8s. 0d. per quarter, or £1 5s. 0d. the course.

VII. An immense quantity of CERTIFICATE HELP is now being given both in the 'GIRLS' MISTRESS' and 'INFANTS' MISTRESS' by *Miss C. I. Dodd*, Lecturer on School Method and Domestic Economy at the Day Training Department, Owens College, Manchester.

VIII. PARSING, ANALYSIS, PARAPHRASING, FOR ROUTINES.

A.—FIRST YEAR.

(*a*) *First Friday* (Men). 'Coming of Arthur,' Lines 499 to 512 for Analysis. Parse *follow, we, whom, flash, King, So, moving, there, mistress, as, Behold, for, have sworn, worship.*

(*b*) *First Friday* (Women). 'The Princess,' 'The Conclusion,' Lines 1 to 12 for Analysis. Parse *So, as, as, mine, for, when, There, pause, said, yielded, What, women, Yet, to bind, could.*

(*c*) *Third Monday* (Men). 'Coming of Arthur,' Lines 20 to 32 for Analysis. Parse *thus, thick, many, therein, none, chase, so that, day, wallowed, anon, lost, housed, would.*

(*d*) *Third Monday* (Women). 'The Princess,' The Prologue, Lines 35 to 44 for Analysis. Parse *miracle, who, being, to force, shunned, when, as, stature, than, falling, like, thunderbolt.*

(*e*) *Fourth Monday* (Men). 'Coming of Arthur,' Lines 94 to 103 for Analysis. Parse *Thereafter, as, who, bright, his, all, clear, that, saw, far, even, star, when, had set.*

(*f*) *Fourth Monday* (Women). 'The Princess,' Canto I., Lines 1 to 11 for Analysis. Parse *prince, amorous, as, first, like, girl, far, There, lived, because, Dying, that, none.*

B.—SECOND YEAR.

(*a*) *First Wednesday* (Men). 'Hamlet,' Act III. Scene iii., Lines 10 to 23 for Analysis. Parse *is bound, To keep, itself, more, whose, lives, Dies, alone, like, gulf, draw, near, wheel, which.*

(*b*) *First Wednesday* (Women). 'Coriolanus,' Act IV., Scene i., Lines 14 to 25 for Analysis. Parse *What, when, Nay, Resume, wont, to say, If, wife, husband, so, adieu, yet, stern.*

(*c*) *Third Monday* (Men). 'Hamlet,' Act III., Scene iv., Lines 53 to 65 for Paraphrase.

(*d*) *Third Monday* (Women). 'Coriolanus,' Act IV., Scene iv., Lines 12 to 22 for Paraphrase.

(*e*) *Fourth Monday* (Men). As in First Year.

(*f*) *Fourth Monday* (Women). 'Coriolanus,' Act IV., Scene v., Lines 67 to 75 for Analysis. Parse *who, particularly, mischief, thereto, may, shed, are, requited, But, memory, only, remains.*

SELECTED GOVERNMENT QUESTIONS.

FIRST YEAR CANDIDATES.

FIRST WEEK.

1. Write in Largehand the words '*Eventually Frustrated.*'
Write in Smallhand the words '*Hateful Juggernaut in Ind, Kali and the idols grim.*'

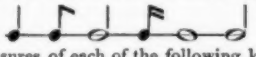
2. Write from Dictation :—

But this exceptional procedure must obviously have failed to meet the wants of a highly organised society, in the midst of which trespasses, aggressions, fraudulent and malicious interference with persons and property, must have been of daily occurrence. The practical remedy was to extend the doctrine of civil obligations in such a way as to attach penal consequences to certain violations of them, and thereby to concentrate in the same court and process civil and criminal jurisdiction.

3. The Code attaches special importance to the study of Drawing in Schools. Describe some of the earliest exercises which should be given in drawing, and say in what relation they stand to a good and complete course of general education.

4. What is the use of '*Paraphrasing*' as an exercise in '*Language*'? Give, as to a Pupil Teacher, some rules which should be observed in attempting to paraphrase a poetical extract, and add a brief example of a good paraphrase of your own of some familiar verse.

5. Write rests equal in value to the following notes :—


OR

Fill up two measures of each of the following kinds, showing half-pulse notes, continuations, and rests in each example. Vary the contents of the measures in each time :—

(*a*) Two-pulse, (*b*) Three-pulse, (*c*) Four-pulse.

6. Bar the following passages in accordance with the time-signatures :—

OR

Write figures over the following to indicate the value of each note and rest :—

s :.l,s | f.m :r.	m.,d :f | m :		
r : — | — :r,m.f	s : — | -. :		
.f :m.r,d | r.m :.,f	m : — | — : —		

7 to 10. Parsing, Analysis, and Composition from Routine.

11 and 12. Maps from Routine.

13. Describe clearly the causes of *two* of the following :—An Eclipse of the Sun, Trade Winds, Monsoons, Land and Sea Breezes, the Region of Calms on either side of the Equator.

14. (*Men*). What is the most thickly peopled part of British N. America? Describe the position and explain the importance of Halifax, Quebec, Montreal, Vancouver, and New Westminster.

(*Women*). Describe the chief plateaux of Asia.

15. What do you understand by the Norman Feudal System? Show what dangers it offered to peace, and how they were kept in check by William the Conqueror, his sons and Henry II. How did the legislation of Edward I. and Henry VII. still further strengthen the central power?

16. (*Men*). Trace the course of Parliamentary events from 1603 to 1649.

(*Women.*) Under what circumstances did Gibraltar, New York, Malta, Quebec, fall into English hands?

17. A train 88 yards long overtook a person walking along the line at the rate of 4 miles per hour, and passed him completely in 10 seconds. It afterwards overtook another person, and passed him in 9 seconds. At what rate per hour was this second person walking? Ans. 2 miles.

18. (*Men.*) (*a*) Prove that $a-(b-c)=a-b+c$.

(*b*) Prove that if $x^2+y^2+z^2=1$, then $(x+y+z)^2=(1+y-z)(1+z-y)+(1+z-x)(1+x-z)+(1+x-y)(1+y-x)$.

(*Women.*) On what arithmetical truths is the ordinary rule for finding the G.C.M. of two or more numbers based? Express each of these truths either in words or by symbols, and give a numerical example of each.

19 (*Men.*) (*a*) Assuming the rule for finding the G.C.M. of two expressions, show how to find it for three expressions.

(*b*) Find G.C.M. of $343p^3q^2r(3x^4-11x^3+7x^2-4x+3)$ and $441pq^2r^3(4x^4-15x^3+11x^2-7x+3)$.

Ans. $49pq^2r(x-3)$.

(*Women.*) In a chest were 13 drawers, in each drawer were 7 divisions, and in each division three purses, each purse containing £6 in gold, 9 half-crowns, and 142 pennies. How much money was in the chest? Ans. £1,906 13s.

20. (*Men.*) The sides of a field are 27, 364, 357, and 76 yards respectively, and the angle between the first two is a right angle. Find area in acres. Ans. 3·81 acres.

(*Women.*) Why is cleanliness in and about the house conducive to health? How would you clean saucepans, tins, windows, and boarded floors?

21. (*Men.*) Write out Euclid II. 4.

In a right-angled triangle the square on the perpendicular drawn from the right angle to the hypotenuse is equal to the rectangle contained by the segments into which the hypotenuse is divided by the perpendicular.

(*Women.*) What considerations would guide you in choosing the furniture of your house? How would you try to make the rooms bright and homelike?

22. (*Men.*) Prove Euclid III. 16.

Describe two circles which shall touch a given straight line at a given point, and also touch a given circle.

(*Women.*) Cut out and tack together one leg of a child's pair of drawers, and show on calico the stitches required in making the garment.

Third Week.

Men.

1. Write a short essay on one of the following subjects:—

(*a*) Thrift.

(*b*) A man's character as shown in his behaviour to other men.

(*c*) The various applications of electricity in modern times.

Grammar.

2. Parse the words in italics in the following passages, and give rules for parsing in each case:—

A doubtful throne is *ice* on summer seas.
Ye come from Arthur's court. Victor his men
Report him. Yea, but ye; think ye, this *king*,
So many *those* that hate him, and so strong,
So few his *knights*, *however brave* they *be*,
Hath body enow to hold his foemen down?

3. I remember in the beginning of Queen Elizabeth's time, an Irish *rebel*, *condemned*, *put up* a petition to the Deputy that he might be hanged in a withie and not in a halter, because it had been so used with *former* rebels. There *be* monks in Russia that will sit a whole *night* in a vessel of water, *till* they be encased with hard ice.

4. Analyse fully the following passages:—

Such sleep
They sleep, the men I loved. I think that we
Shall never more at any future time
Delight our souls with talk of knightly deeds
Walking about the gardens and the halls
Of Camelot, as in the days that were.

5. Certainly the best means to clear the way in this same wood of suspicions is frankly to communicate them with the party that he suspects, for thereby he shall be sure to know more of the truth of them than he did before.

6. Explain the terms—Simple, Complex, and Compound, as applied to sentences; and analyse—'Methinks the lady doth protest too much.'

7. A Factitive Verb in its active form has two completions—(1) a word in the objective case; (2) A word in the objective case, or an adjective or an infinitive. Give examples of each kind; and express the same thought in the passive form.

8. Explain the terms—Regular, Irregular, Strong, Weak, as applied to verbs; and classify the following verbs as Regular or Irregular, and as Strong or Weak—fall, fell, fly, flee, flow, hurt, raise, rise, sit, set, sell, spend.

9. Comment on—heathen horde, Excalibur, mage Merlin, Tintagil, samite, vert and azure, great lords from Rome.

10. Reproduce, in your own words, the substance of Bacon's Essay on Nobility *or* on Travel.

(Women.)

1. Write a short life of Macaulay, and mention his principal works.

2. What were Byron's views about the school of poets of which Pope was the chief?
Show how far and in what poems, Byron imitated Pope, and in what particulars his own writings differed from that model.

3. Explain the following passage, and the connection in which it stands:—

'But sadness on the soul of Ida fell,' *to*
'And found fair peace once more among the sick.'

4. Parse *blent*, *Clamb*, *void*, *was*, *her*, *use*, *Expunge*, *world*, *waste*, *it*, *seemed*, from passage in question 3.

5. Analyse last 3½ lines of above passage.

6. Say what you know about the origin, structure, and meaning of these words:—*Hatred*, *disastrous*, *blacken*, *expunge*, *secret*, *fared*.

7. What is meant by Syntax? Give, with examples, three of the most important syntactical rules. Explain why English has fewer of such rules than some other languages.

8. As for Men.

9. Give examples of the same word used in one sentence as Preposition, in another as Adverb, and in a third as Adjective. Explain, as to children, how you would distinguish between these three uses.

10. Take the prefixes *un-*, *con-*, *be-*, *trans-*, *de-*, and the affixes *-tion*, *-fy*, *-ness*, *-ful*, *-ble*, and show by examples (*a*) from what language they come, and (*b*) how they affect the meaning of the words to which they are attached.

SECOND YEAR.

First Week.

1. As in First Year.

2. As in First Year.

3. Give some familar examples of '*False Induction*,' and say what kind of school exercises are best calculated to encourage the habit of making a true use of the inductive process.

4. What is the exact meaning of '*Organization*' as applied to a school? Say how you would organize the work of a mixed school of 200 children, of whom 50 were under seven years of age, what staff you would require, and how you would distribute the work among them.

5. As in First Year.

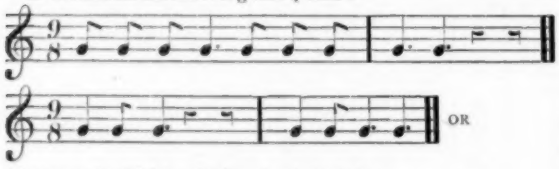
CERTIFICATE ROUTINE FOR MAY 1894 (MEN AND WOMEN, FIRST YEAR).

DAYS	FIRST WEEK.			SECOND WEEK.			THIRD WEEK.			FOURTH WEEK.		
	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.
MONDAY	Analysis of the Mental Powers	Study Bacon's Essays, 1, 2, 4 *or* 'Byron,' pp. 1 to 13	Euclid, Book III., Props. 32 to 37 *or* Repairing Underclothing	The relative educational value of subjects ordinarily taught	Read Bacon's Essays, 5, 9, 11 *or* pp. 131 to 145 of 'Princess' (Notes)	Euclid, Book III., Props. 1 to 8 *or* Cutting out of a Pair of Drawers	The influence of School Apparatus on the Intelligence	Analyse, etc. (*See Article*)	Euclid, Book III., Props. 9 to 15 *or* Any Needlework	Moral Training	Analyse, etc. (*See Article*)	Euclid, Book I., Props. 40 to 48 *or* The Common Faults of Needlework
TUESDAY	Chief Dates from 1714 to 1748	Problems involving Quadratics *or* Composition of Food	Pacific Coast of N. America *or* Productions and Commerce of S.W. Asia	Chief Dates from 1748 to 1763	Algebraic Factors *or* Clothing Outfits	Motions of the Earth	Poetry from 1603 to 1702 *or* Lives of Great men from 1066 to 1153	Arithmetical Progression *or* Stoves and Kitchen Ranges	Atlantic Coast of N. America *or* Political Geography of S.W. Asia	Chief Dates from 1763 to 1783	Harmonical Progression *or* Composition and Functions of Air	The Flora and Fauna of Mountains
WEDNESDAY	Square Root	Drawing	Science	Stocks	Drawing	Theory of Decimals	Historical Dates	Study Lecture IV. *or* Syntax	Problems on Proportional Parts	Partnership	Lives of Great Men	Coast of G. of Mexico and of British N. America *or* Geography of Russian Asia
THURSDAY	History from 1714 to 1744 *or* History of 'The Standing Army'	Problems involving Simultaneous Simple Equations *or* Nutritive Value of Food	Map of Pacific Coast of N. America *or* Physical Map of Hindostan	History from 1744 to 1763	Algebraic Factors *or* Manufacture of Clothing	The Atmosphere, Rain, Clouds, and Vapour	Constitutional Affairs from 1215 to 1461	Geometrical Progression *or* Papering and Colouring Rooms	Map of Atlantic Coast of N. America *or* Map of Palestine	History from 1763 to 1783	Theory of the Simple Rules of Algebra *or* The Respiratory Organs	Problems on Work and Pipes
FRIDAY	Drawing	Deductions of Euclid, Book I. *or* Diagram of a Pair of Drawers	Analyse, etc. (*See Article*)	Cube Root *or* Stocks	Accidence of Nouns and Pronouns	Science	Composition on 'Presence of Mind'	Deductions of Euclid, Book II. *or* Cutting out of a Woman's Chemise	Read Second Half of 'Coming of Arthur' *or* pp. 14 to 27 of 'Byron'	Notes of a Lesson on 'The Beaks of Birds'	Race Problems	Read Notes on 'Coming of Arthur' pp. 33 to 42 *or* pp. 146 to 160 of 'Princess' (Notes)
SATURDAY	Music, Accent and Contents of Bars *or* Continuations, Rests, etc.	Science / Drawing	Deductions of Euclid, Book II. *or* Any Domestic Economy	Music, Transposition from one time to another	Examination (*Two Hours*)	Deductions of Euclid, Book III. *or* Any Arithmetic	Musical Terms	Science / Drawing	Euclid, Book I., Props. 27 to 39 *or* Proofs of Arithmetical Rules	Musical Rudiments	Examination (*Two Hours*)	Composition on 'It is Never too Late to Mend'

CERTIFICATE ROUTINE FOR MAY 1894 (MEN AND WOMEN, SECOND YEAR).

DAYS	FIRST WEEK.			SECOND WEEK.			THIRD WEEK.			FOURTH WEEK.		
	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.
MONDAY	Jevons' Logic, pp. 37 to 53 *or* Cartwright's 'Mental and Moral Science'	Read 'Hamlet,' Act I. (Notes) *or* 'Coriolanus,' Act III., Scene 3, Act IV., Scenes 1–4	Euclid, Book VI., first 8 Props. *or* Print and Linen Patches	The Playground	Euclid, Book VI., first 17 Props. *or* Any Sewing	Study First Half of Notes to 'Coming of Arthur' *or* 'Spenser,' Chapter III.	Notes of a Composition Lesson to Standard IV.	Deductions on Euclid, Book VI. *or* Cut out on Paper a Boy's Shirt and Child's Pinafore	Paraphrase. (*See Article*)	'Quick,' Chapter XVIII.	Euclid, Book VI., first 17 Props. *or* Any Needlework	Analyse, etc. (*See Article*)
TUESDAY	As in First Year *or* Revision	Cube Root *or* Square Root	As in First Year — Political Geography of Scotland	As in First Year *or* From 1558 to 1587	Drawing	As in First Year — Geography of Ireland	As in First Year *or* Social History from 1547 to 1603	Mental Arithmetic	As in First Year — Physical Geography of Victoria and N.S. Wales	As in First Year *or* Scientific and Commercial Advance from 1547 to 1603	Theory of G.C.M. and L.C.M.	As in First Year — Geography of South Australia and Queensland
WEDNESDAY	Analyse, etc. (*See Article*)	Binomial Theorem *or* Household Expenses	The Code Requirements of the Standards in the three R's	Read Notes on Act II., 'Hamlet,' *or* 'Coriolanus,' Act IV., Scenes 5, 6, 7: Act V., Scenes 1, 2	'Quick,' Chapter XVII.	Logarithms *or* Food for Dyspeptics	Mensuration *or* Any Revision	Jevons' Logic, pp. 53 to 71	Interest and Annuities *or* Penny Dinners for School Children	Jevons' Logic, pp. 71 to 88 *or* Cartwright's 'Mental and Moral Science'	Interest and Annuities *or* Domestic Economy as a Class Subject	Problems of Motion
THURSDAY	As in First Year *or* History from 1547 to 1558	Science	As in First Year — Maps of New South Wales and Wales	As in First Year *or* From 1587 to 1603	Science	As in First Year — Geography of New Zealand	As in First Year *or* Lives of Great Men from 1457 to 1603	Stocks	As in First Year — Maps of Queensland and Ulster	As in First Year *or* Religious Movements from 1547 to 1603	The Progressions *or* Disinfectants	As in First Year — Geography of New Zealand
FRIDAY	Algebraic Interest *or* Food for the Sick	Deductions of Euclid, Book III. *or* Hedge-tears and Diagonal Darns	Drawing	Logarithms *or* Treatment of Skin Diseases	Revise Euclid, Book III. *or* Draw all the required Diagrams	Mensuration *or* Any Revision	Permutations and Combinations *or* School Penny Banks	Revise Euclid, Book I. *or* Describe the Different Methods of Darning	Read Bacon's Essays, 25, 27, 28 *or* 'Spenser' Chapter IV.	Quadratics *or* Vaccination	Deductions on Euclid, Book VI., *or* Any Needlework	Revise any English
SATURDAY	Music, Major and Minor Scales	Science	Drawing	English Composition upon the Character of Hamlet *or* Coriolanus	Music, Value of Notes and Rests	Examination (*Two Hours*)	Science *or* Drawing	Musical Terms in Common Use	Science	Drawing	Paraphrase (*See Article*)	Music, Compass and Registers of Voices	Examination (*Two Hours*)	Repetition, Literature, and Penmanship

6. Transcribe the following into $\frac{9}{8}$ time :—



Note tests for Division IV. In schools include :—

'*A simple passage containing a transition of one remove indicated by bridge-notes.*'

Write two passages, one changing to the first sharp key, and one changing to the first flat key, of not more than 20 notes each, in accordance with these requirements. Do not write in time.

7 to 11. Analysis, Paraphrasing, and Composition from Routine.

12 and 13. Maps from Routine.

14. (*Men.*) As in First Year.

(*Women.*) Give a full description of Queensland, with its chief vegetable and mineral products.

15. (*Men.*) As in First Year.

(*Women.*) Give some account of the aboriginal inhabitants of Australia and New Zealand respectively, and mention what you know of our relations with these races.

16. (*Men.*) As in First Year.

(*Women.*) What were the main principles of Wolsey's (1) foreign, (2) home, policy?

On what charge was he finally ruined?

17. (*Men.*) As in First Year.

(*Women.*) Henry VII. ascended the throne with a Parliamentary title. What precedents were there for the regulation by Parliament of the succession to the Crown?

18. (*Men.*) (*a*) Prove that the sum of the roots of the equation $x^2 - px + q = 0$, is p and their product is q.

(*b*) If α, β be the roots of $\frac{h}{a-x} + \frac{k}{b-x} = 1$, then shall $\frac{(a-\alpha)(\beta-a)}{a-b} = h$; and $\frac{(a-b)(\beta-b)}{b-a} = k$.

(*Women.*) (*a*) In teaching division by factors, how would you explain the way to find the remainder? (Take as an example, $5589 \div 35$.) Ans. $159\frac{24}{35}$.

(*b*) Give and prove the rule for division in decimals.

(*c*) Explain the rule for finding the present value of a given sum, due after a given time, at a given rate per cent. simple interest.

(*d*) Define notation, interest, recurring decimal, brokerage. Give examples.

19. (*Men.*) Solve the equations :—

(*a*) $\frac{2x+1}{29} + \frac{471-6x}{2} = 9 + \frac{402-3x}{12}$.

Ans. $x = 72$.

(*b*) $\frac{2x-5}{x-3} + \frac{2x}{x-4} = \frac{25}{3}$. Ans. $x = 6$ or $3\frac{1}{13}$.

(*c*) $\begin{cases} x^3 + y^3 = 468. \\ x^2y + xy^2 = 420. \end{cases}$ Ans. $\begin{matrix} x = 7 \text{ or } 5. \\ y = 5 \text{ or } 7. \end{matrix}$

(*Women.*) A rectangular field of two acres is to be divided into allotment gardens amongst a number of labourers. Supposing each portion is 121 ft. by 36 ft., how many men can have portions?

Ans. 20 men.

20. (*Men.*) Find the curve surface of the frustrum of a cone whose top and bottom diameters are 4 and 6 feet and slant side 8 feet. Ans. $125\frac{5}{7}$ sq. ft.

(*Women.*) Cut out and make up in lined paper the upper part of a woman's night-dress and one sleeve (half size).

21. (*Men.*) Write out Euclid VI. 7.

If two triangles, which have two sides of the one proportional to two sides of the other, have the angles opposite one pair of homologous sides equal, the angles opposite the other pair of homologous sides are either equal or supplementary.

(*Women.*) Give good receipts for making beef-tea and barley-water. Name other simple beverages suitable for convalescents. Describe in detail how you would 'make tea.'

22. (*Men.*) Write out Euclid VI. 11.

From a given rectangle cut off a similar rectangle by a straight line drawn parallel to two of its sides.

(*Women.*) Why is nicety of cookery and serving-up so important in the case of invalids? Why should food never be kept in a patient's room?

Third Week.

(*Men.*)

1 to 5. As for First Year, *Men.*

6. Paraphrase :—

(*a*) This is the very ecstasy of love
Whose violent property fordoes itself,
And leads the will to desperate undertakings
As oft as any passion under heaven
That does afflict our natures.

(*b*) The single and peculiar life is bound,
With all the strength and armour of the mind,
To keep itself from noyance; but much more
That spirit upon whose weal depend and rest
The lives of many.

7. Explain eight of the following :—

Then no planets strike—like Niobe—the Nemean lion's nerve—the paragon of animals—the altitude of a chopine—of the chameleon's dish—the mutines in the bilboes—this quarry cries on havoc—I bought an unction of a mountebank—Bellerus old.

8. Explain the following passages, stating the circumstances under which they occur :—

(*a*) Unhousel'd, disappointed, unanel'd.

(*b*) The other motive
Why to a public count I might not go
Is the great love the general gender bear him.

9 and 10. As for First Year, *Men.*

(*Women.*)

1. Mention the peculiarities of Shakespeare's versification; particularly the rhyming couplets.

2. Paraphrase the following passage :—

'O good but most unwise patricians, why' *to*
'When, both your voices blended, the greatest taste
Most palates theirs.'

INDEPENDENTLY TRAINED TEACHERS' LIST.—DECEMBER, 1893.

YEARS.	MEN.												WOMEN.												TOTAL.											
	Sat.	Passed.								Failed.			Sat.	Passed.								Failed.			Sat.	Passed.								Failed.		
		1st Class.		2nd Class.		3rd Class.		Total.						1st Class.		2nd Class.		3rd Class.		Total.						1st Class.		2nd Class.		3rd Class.		Total.				
	—	No.	P.C.	No.	P.C.	No.	P.C.	No.	P.C.	No.	P.C.		—	No.	P.C.	No.	P.C.	No.	P.C.	No.	P.C.	No.	P.C.		—	No.	P.C.	No.	P.C.	No.	P.C.	No.	P.C.	No.	P.C.	
First Year ...	520	22	4	88	17	267	52	377	73	143	27		2527	146	6	521	21	1419	56	2086	83	441	17		3047	168	6	609	20	1686	55	2463	81	584	19	
Second Year ...	352	28	8	121	34	195	56	344	98	8	2		1948	62	3	427	22	1118	57	1607	82	341	18		2300	90	4	548	24	1313	57	1951	85	349	15	
Total ...	872	50	6	209	24	462	53	721	83	151	17		4475	208	5	948	21	2537	57	3693	83	782	17		5347	258	5	1157	22	2999	56	4414	83	933	17	

3. Analyse the last portion beginning with '*You are plebeians.*'

4. Parse *Hydra, here, That, shall, but, horn, he'll turn, his, as, Let, have, no, less, both, voices blended, theirs.*

5. Explain the following expressions :—(*a*) '*Let us revenge this with our pikes, ere we become rakes.*' (*b*) '*The one side must have bale.*' (*c*) '*Would the nobility lay aside their ruth?*' (*d*) '*To help our fielded friend.*' (*e*) '*Despatch those centuries to our aid.*' (*f*) '*Send us to Rome the best, with whom we may articulate.*'

6. What anachronisms do you discover in 'Coriolanus'?

7. What were Spenser's chief works? What colouring did they take from his surroundings?

8. Mention with details Spenser's Irish friends.

9. Describe the 'scenes of Glenmalure and Smerwick.'

10. Comment upon 'If Elizabeth had allowed him he would now have made a Mahommedan conquest of the whole island.'

CORRESPONDENCE.

We shall be pleased to reply briefly through these columns to any SUBSCRIBER *seeking examinational information or advice, and* **Enclosing the Necessary Coupon.**

This privilege does not, of course, extend to furnishing the solutions and answers of problems. All such communications should be addressed to 'THE QUERY EDITOR.'

Replies demanding urgency will be promptly forwarded per post on the receipt of a stamped and addressed envelope, **Accompanied by the Requisite Coupon.**

A post will be saved by writing direct to DR. GEORGE BEACH, M.A., **(Examination Editor of 'Practical Teacher')** STANLEY MOUNT, MACCLESFIELD.

E.M. (Wisbech).—After the May Examinations we shall give more time to 'Language.' You will see that we have inserted Certificate French Exercises. We have precisely the same requests for Latin.

J.W. (Laxey).—See Certificate Article.

G.M.E. (Cavendish Square).—(1) Crowded out; will try next month; (2) Not yet published.

M.S. (Leigh).—She had better prepare it, but she will get no marks for it.

E.J.J. (Aberystwith).—Davies' Historical Manual (1640–1660), George Philip and Son.

ANSWERED PER ORDINARY LETTER.—F.K.M. (Peel); A.S. (Ulverston); R.N. (Burton); YSTWYTHIAN (Aberystwyth); E.J.L. (Willington); M.H. (Beverley); L.D. (Dover); M.F.H. (Alcester); G.C. (Parton); W.R.S. (Tividale); A.L.M. (Topsham); A.F. (Strood); V.A. (Cardiff); C.B. (Alderley); A.H. (Buckland); W.G. (Brighton); A.L. (Cape Colony); M.D. (Llangollen); T.T. (Stockport); S.S. (Castleton); U.L.N. (Brighton); G.M.C. (Cavendish Square); J.H. (Pensnett); E.L.P. (Taigarth); R.R.S. (Dundee); K.C. (Thurso); H.W.B. (Eglingham); C.B. (Lowestoft); S.B. (Oldbury); J.D.S. (Market Rasen); G.W.P. (Tredworth); M.P. (Forest Gate); F.K. (Streatham Hill); M.I.C. (Oban); M.B. (Orton Waterville); L.N. (Old Trafford); E.O.S. (Yaxley); J.L.J. (Carmarthen); A.F. (Birkenhead); T.S. (Birkenhead); A.S. (Birkenhead); G.B. (Nether Edge); F.C.W. (Lincoln); E.H.D. (Congleton); F.G.E. (Hazel Beach); H.C. (Godalming); W.W.W. (Salford); F.W. (Westward St.); S.R. (Nuneaton); J.M. (Belfast); C.F. (Ipswich); W.C. (Burslem); F.W.D. (Beccles); W.H.L. (Crayford); W.K. (Buttershaw); S.B. (Crewe); E.C. (Chester); J.B.B. (West Bromwich); W.C. (Middlesbro'); J.B.H. (——); H.C.E. (Hartley Witney); E.T.B. (Carmarthen T.C.); W.W. (Peterbro' T.C.); E.P. (Kidderminster); J.G.P. (Pitlochry); F.K.M. (Peel); A.L. (Liverpool); T.M. (Birkenhead); E.K. (Yiewsley); C.C.K. (Chelsea).

EXERCISES IN FRENCH FOR CERTIFICATE EXAMINATION.

The following are translations of, and notes on, the passages italicised in the April number of the PRACTICAL TEACHER, to which students are recommended to refer :—

A.—(i) *Vinrent à passer près de là* = chanced to pass close by.

Le chemin de Nottingham = the road *to* Nottingham.

(ii) *L'ourse va trouver sa voisine* = the bear *goes and finds* her neighbour.

So *viens trouver* = comes and finds.

Collect the verbs which govern an infinitive without an intervening preposition.

Venait de naître = had just been born.

Gardez-vous-en bien = beware of so doing; or, be sure you don't do that.

D'autres ourses = other bears.

N.B.—When an adjective (*autres*, for example) comes between the partitive article and the noun, the partitive article is expressed by *de* only.

Thus *d'autres ourses* = other bears; *des autres ourses* = of the other bears.

Compare and note the following three idiomatic uses of *venir* :—

Il vient me voir = he comes to see me, *or* he comes and sees me.

Il vient de me voir = he has just seen me.

Il vint à me voir = he happened to see me.

(iii) *Après lui avoir fait leurs compliments* = after having paid him their compliments.

Note.—All prepositions except *en* (which governs the present participle, or, more correctly, the gerund in *-ant*) govern the infinitive.

Je saurai bien régner et me faire craindre = I *shall be able* to reign and make myself *be feared.*

Note.—Savoir = to be able, where the ability is *intellectual; pouvoir* = to be able, where the ability is *physical.*

Also, that the infinitive that follows *faire*, if that infinitive be transitive (as in this case, *me* being the object) has a *passive* meaning.

B.—(i) *De la journée* = of the day, or day's work, not *journey*, which is translated by *voyage.*

Souvent il m'arrivait d'oublier ma nouvelle fortune = it often happened that I forgot my new experience.

Les trompettes venaient à sonner = the bugles chanced to sound.

Refer to the above note on the idiomatic uses of *venir.*

Échappé aux périls = escaped *from* the perils.

Most verbs denoting *deprivation* take *à* with their complements; *ôter à, emprunter à, dérober à; e.g., On a ôté sa place à Guillaume* = they have taken William's situation from him.

Nous avons emprunté deux livres à votre frère = we have borrowed two pounds of your brother.

On a dérobé le scélérat à la justice = they have screened the scoundrel from justice.

(ii) *Tu te souviens de ce que te disait ta mère* = you remember what your mother used to say to you.

Note *se souvenir* takes *de* with its complement.

Also *ce que* cannot be nominative.

Plus on est jeune, mieux on s'entend avec ceux qui le sont = *the* younger one is, *the* better one *gets on* with those who are *so.*

Notice the omission of the adverbial *the* in French. *So*, when used pronominally in English, is translated generally by the pronoun *le; e.g.*, 'Êtes-vous content qu'il ait réussi?' 'Je *le* suis.'

J'ai grand'peur qu'une femme de trente ans, n'apprenne avec peine à babiller avec des marmots = I am very much afraid that a woman thirty years of age learns with difficulty to chat with little brats.

N.B.—Verbs and phrases denoting *fear* used affirmatively, when followed by a subordinate affirmative sentence, require *the verb in the latter sentence to be in the subjunctive mood*, and to be preceded by an *untranslatable negative.* Collect, as you proceed, all those phrases which require this negative.

Qui ne sait pas ce que c'est que d'être mère = who does not know what it is to be a mother.

Note the untranslatable *que* before the infinitive in apposition with *ce.* Also the omission of the article before the appositive complement *mère.*

Pour leur faire entendre raison = to make them listen to reason.

Notice (*a*) the omission of the article before an abstract noun in common phrases that express *one* idea which might be expressed by one word did the language possess it; *e.g., avoir patience, perdre courage*, &c., &c.

(*b*) The idiom in this passage is very important and somewhat difficult. To understand it compare these sentences.

(*a*) 'Nous *les* avons fait aller' = we have made them go.

Observe that here we use the accusative pronoun *les*, and that the complementary infinitive is intransitive.

(*b*) 'Nous avons fait raccommoder nos bottes à ces cordonniers' = we have had our boots mended by those shoemakers.

Observe that the agent is expressed by *à* with its complement, *i.e.*, by the dative case; and that the active infinitive of the *transitive* verb following *faire* has a passive meaning.

(*c*) 'Nous leur avons fait raccommoder nos bottes' = we have had them mend our boots.

Here, instead of a noun for the agent, we have a pronoun, and this has to be in the dative case—*leur.*

This explains the use of *leur* in the passage, 'pour *leur* faire entendre raison.'

(iii) *C'est dans ce Paris qu'il faut le lire* = it is in this Paris of ours that it must be read.

Une fraîche matinée riante = a fresh smiling morning.

Note that the present participle is invariable except when used simply as an adjective.

Il n'y a rien qui ne nous le rende présent et comme vivant une seconde fois = there is nothing which does not make it present to us, and, as it were, alive a second time.

Notice.—(*a*) That the adjective clause qualifying *rien* and similar words always requires the verb in the subjunctive.

(*b*) That when the word *make* in English is followed by a factitive adjective, *make* must be translated by *rendre*, and not by *faire*.

II. A.—*First Year Students.*

Translation of, and notes on, the sight tests from English into French, given in the April number of the PRACTICAL TEACHER.

(i.) 'Tu as raison,' répondit froidement la mouche; 'on a toujours tort de s'approcher d'une nation aussi fougueuse que la vôtre.'

Collect the idiomatic phrases (about a dozen) like *avoir raison*, *avoir tort*.

Note that words denoting nearness are followed in French by *de*.

(ii.) Il ne songeait pas à ce qu'elle lui avait dit.

Note (*a*) the *e* mute before *a* and *o* in conjugating verbs in *-ger*; (*b*) the dative pronoun *lui*; (*c*) that there is no progressive form in French.

(iii.) Si Alexandre n'avait pas été grand guerrier, il n'aurait pas subjugué le monde.

Note the omission of the article before the appositive complement *guerrier*.

(iv.) Je veux lire beaucoup de livres allemands, afin que je puisse parler la langue allemande (or, afin de pouvoir parler).

Notice (*a*) that *vouloir* and *pouvoir* take no preposition before their infinitive complements; (*b*) that *proper adjectives* take a small letter, and always follow the noun they qualify; (*c*) that final sentences (*i.e.*, sentences denoting purpose) take the subjunctive.

(v.) Je l'ai connue depuis qu'elle avait dix ans.

Note.—(*a*) *Connaître*, not *savoir*, must be used here. *Connaître* is used of a person or thing; *savoir* of a fact—*e.g.*, *Je sais que vous avez faim.*

(*b*) *Connue* agrees in number and gender with *la*, the direct object, because the auxiliary is *avoir*, and the direct object precedes the verb.

(*c*) The idiom *j'ai dix ans* = I am ten years old.

(vi.) Il y a six ans que ces enfants *sont* à l'école, et il paraît qu'ils font des progrès.

Note (*a*) the use of the *present* tense instead of the perfect when the action has been going on up to the present moment; *cf.*, *Il y avait dix ans qu'ils étaient en Suisse* = they *had been* in Switzerland for ten years.

(*b*) That 'progrès' is used in the plural.

(vii.) Deux heures venaient de sonner, lorsque l'homme me frappa.

The idiom *venait de frapper* is explained above. Note the difference between *sonner* and *frapper*.

(viii.) J'espère qu'il fera beau demain, car nous allons visiter l'Exposition.

Notice (*a*) *faire* is used in phrases about the weather; *e.g.*, *il fait froid*; *il fait sombre.*

(*b*) 'Aller' takes no preposition before the infinitive complement.

(ix.) 'À quoi pensez-vous?' 'Je pense *à* votre frère; que pensez-vous *de* son aventure?'

Note.—(*a*) Verbs of thinking take *à* before their complement, but *penser*, meaning 'to form an estimate of,' requires *de*; (*b*) that although *aventure* is feminine, the masculine form *son* must be used for euphony.

(x.) Il *fait* froid aujourd'hui; mon frère et moi, nous *avons* froid; notre thé *est* froid aussi.

Note that the idiom *avoir froid* applies to *persons*, not to *inanimate objects.*

II. B.—*Second Year Students.*

(i.) *Il quitta le premier* la table de chêne où il prenait avec ses apprentis les repas journaliers. Tous se levèrent à ce signal, et vinrent se ranger en silence auprès de leurs tours; le maître au milieu d'eux, *chacun* reprit le travail avec activité.

Note (*a*) *d'abord*, = at first, will not do here.

Il quitta le premier = he was the first to leave.

(*b*) *Chacun* is a pronoun; *chaque* an adjective.

(ii.) Dites toujours la vérité, c'est un moyen plus honnête et plus profitable pour réussir que le plus adroit mensonge.

Note *dites*, *faites*, *êtes* = the three cases where the 2nd plur. pres. indic. ends in *s* instead of *z*. In old French, s, x, and z were interchangeable letters.

(iii.) 'Ce vase ne nous appartient pas; il est à M. le président, qui l'avait envoyé avec du bouillon pour ma mère.'

—'*J'en suis bien fâché*,' répliqua durement le potier; 'cela t'apprendra à avoir plus de soin des choses qui ne t'appartiennent pas; *je n'y puis rien.*'

Note (*a*) *fâché de* = to be sorry for; *fâché contre* = to be angry with; (*b*) *je n'y puis rien* is an idiom; *lit.*, I am able (to do) nothing to it (or in the matter). It translates our 'I can't help it.'

(iv.) Toutefois, au bout de quelques jours, on vit reparaître l'enfant tenant (or *qui tenait*) dans sa main les deux sous et demi qu'elle redevait au potier; celui-ci, surpris et content, lui dit.

'C'est bien, fillette; car tu aurais pu te dispenser de revenir, puisque je ne *connais* ni ton nom, ni ta demeure, ni la profession de tes parents.'

Note (*a*) *voir* and *pouvoir* take no preposition with the infinitive complement; (*b*) that *savoir* will not do here instead of *connais*. See note above.

(v.) À cet appel matinal, Marguerite *s'était levée* bien doucement de son grabat. Les ténèbres régnaient encore dans leur demeure, et néanmoins elle trouva ses vêtements dans l'obscurité et s'habilla comme *en plein jour*, tant elle avait d'ordre et de soin. Elle ouvrit sans bruit la porte, et courut d'un pas léger vers la fontaine pour y baigner son visage et ses mains, et lisser *son* épaisse chevelure.

Note s'était levée. Reflexive verbs form their compound tenses with *être*, and the participle agrees with the reflexive pronoun if it be the direct object (as in this case).

(vi.) En ce moment quelque chose remua dans un coin obscur du galetas (or *mansarde*, f.); un petit garçon *à demi vêtu* en sortit, *se glissant à tâtons* vers le poêle. Elle courut *à sa rencontre*, prit sa tête entre ses mains et l'embrassa tendrement. Il lui *rendit* ses caresses.

Note (*a*) *à sa rencontre* = (literally) to his meeting, *i.e.*, to meet him; (*b*) *rendre* must be used (not *revenir* or *retourner*) to translate *return* = give back.

A.—FRENCH-ENGLISH SIGHT-READING TESTS.

I.—*First Year Students.*

(i.) Il y avait dans les anciens Gaulois un caractère de valeur et de vivacité; ils ne respiraient que la guerre. Toujours armés, même en temps *de paix*, *ils se battaient entre eux*, lorsqu'ils n'avaient point d'ennemis étrangers à combattre. Leur humeur indomptable *les rendait inquiets*, querelleurs, vains, et duellistes, car les combats singuliers étaient pour eux une sorte d'amusement.—*Millot.*

(ii.) La France a toujours été célèbre *à juste titre* pour sa fertilité; elle produit presque tout ce qu'on peut désirer, pour les besoins, les commodités, et les plaisirs de la vie. Son climat la rend une *des meilleures et des plus agréables* contrées de l'Europe; *elle n'est sujette ni aux froids* rigoureux des climats qui sont plus au nord, ni aux chaleurs excessives de ceux qui sont plus au midi.—*Des Carrières.*

(iii.) Paul passa une nuit très-agitée, et *ce ne fut que* vers le milieu du jour suivant que le fièvre diminua. Sa mère ne l'avait pas quitté, craignant et espérant *tour à tour*. *A grand'peine* la sœur hospitalière *parvint à lui faire accepter* un peu de nourriture. Enfin, vers le soir, voyant que Paul souffrait beaucoup moins, elle se décida à *retourner* chez elle pour prendre quelles heures de repos.—*Mme. Tullie Moneuse.*

(iv.) La disparition des deux enfants avait jeté *celle-ci* dans *d'inexprimables angoisses*; le désespoir lui avait donné des forces, elle *était parvenue* à mouvoir ses jambes impotentes et à s'habiller elle-même. Lorsque le président arriva et *lui eut tout raconté*, la pauvre mère ne put articuler un seul mot; mais elle se dirigea en chancelant vers un coin de la chambre, y prit une béquille (*crutch*) et *se disposa à se rendre* à l'hospice. Elle marchait *sans écouter le président*, qui *s'efforçait de la consoler*; celui-ci fut obligé de fermer la porte et *d'en remettre la clef au propriétaire*, qui par hasard *se trouvait* dans la cour.—*Mme. Tullie Moneuse.*

(v.) Plusieurs jours *s'étaient écoulés sans que Mme. Robert eût revu le célèbre docteur*, et elle se trouvait *à la veille* de repartir pour Dôle (name of a place). Elle se rendit à l'Église avec ses enfants, pour *remercier Dieu de sa* guérison et de celle de Paul. *Sa prière achevée*, comme elle se préparait à sortir, elle aperçut devant elle une jeune fille *à genoux* sur les dalles (flag-stones).—*Moneuse.*

(vi.) Mon paquet fut bientôt fait; *je ne possédais à peu près que les habits* dont *j'étais vêtue*, et la montre de mon père fabriquée par lui-même; c'est celle que je porte encore, et je *ne l'ai jamais quittée*. *Bien des fois* j'ai eu froid ou faim; mais j'ai tout souffert plutôt que de vendre ce dernier souvenir. Le reste de *mon histoire ne vaut pas la peine d'être raconté.—Moneuse.*

Second Year Students.

(i.) Chaque soir de beau temps la petite famille se promenait dans les campagnes délicieuses qui environnent la ville, et toujours un site nouveau, un tableau inattendu s'offraient à leurs regards surpris et charmés. Ce doux régime agissait très-heureusement sur Mme. Robert ; mais l'admiration *dont elle et sa fille ne pouvaient toujours retenir l'expression* était une cause de tristesse toujours croissante pour Paul. Sa cécité lui devenait chaque jour plus douleureuse ; il avait des heures de désespoir où il demandait à Dieu avec larmes *s'il serait à jamais privé* des joies de la lumière.

(ii.) Le lendemain était un beau dimanche plein de fraîcheur et de soleil ; les vapeurs brumeuses qui s'étendent ordinairement sur Plombières, *s'étaient dissipées dès le matin*, et les oiseaux volaient sans contrainte dans l'air bleu du ciel. Dans la partie haute de la ville, sur la route d'Epinal, à l'une des dernières maisons, on pouvait remarquer une petite fille qui s'avançait de *temps en temps* sur le seuil d'une porte ouverte, regardant toujours *du côté du grand bassin*.

(iii.) Mme. Robert et ses enfants ignoraient ce qui *s'était passé à la vente publique*. Tous trois *étaient de retour* dans le misérable logement qu'ils avaient *loué* le jour même où Marguerite était sortie de prison ; toutes les épargnes de celles-ci avaient été employées à payer un terme d'avance, *seule condition à laquelle on avait voulu les recevoir ;* il ne restait à la pauvre famille aucune ressource ni *aucun moyen de s'en procurer*. Cependant la neige continuait à tomber en tourbillons pressés, la brise sifflait tristement dans les murailles disjointes du vieux logement ; et *pas de bois au foyer, le pain allait finir, plus de grain pour l'oiseau silencieux*.

(iv.) Le lin (flax), la navette (rape) et le sarrasin (buckwheat) s'étendaient en nappes d'azur, d'or et de neiges dans la plaine, leurs parfums s'unissant aux pénétrantes émanations des sapinières. Quelques rares peupliers au feuillage léger *se dressaient* comme des mâts, à côté des saules rabougris (stunted) *aux rameaux grisâtres*. Des massifs de châtaigniers vigoureux, d'élégants tilleuls contrastaient avec *le vert foncé des bouquets de sapins* au milieu desquels apparaissait quelque roche nue et décharnée, comme une ruine solitaire.

B.—ENGLISH-FRENCH TRANSLATION.

First Year Students.

These passages will be translated and certain passages explained in the June number of the 'PRACTICAL TEACHER.'

(i.) There is a mirror at the bottom of the water ; I have just seen myself in it.

(ii.) Paul rushed (*s'élancer*) to meet him, took the hand his benefactor held out (*tendre*) to him, and kissed (*baiser*) it with tender gratitude.

(iii.) The widow (*veuve*) had heard only some words of the conversation (*entretien*, m.) which had just taken place (*avoir lieu*) ; she hoped, however, that the protection of the excellent doctor might (cond. pres. of *pouvoir*) be useful to her children.

(iv.) The sanctity (*sainteté*) of the place had prevented her speaking to the young girl ; but when she found herself in the porch she thanked her for her polite attention.

(v.) It was breakfast time (*the hour of breakfast*), the tables were occupied by travellers from all countries ; I sang without troubling myself too much, and I earned (*gagner*) a crown (*écu*, m.)

(vi.) This resolution had just been taken, when the great surgeon (*chirurgien*), whom we (*on*) had not seen for several days, entered suddenly (*tout à coup*) ; the expression of his features was still more benevolent (*bienveillant*) and calm (*serein*) than usual (*d'habitude*).

Second Year Students.

(i.) She arranged their little room as neatly as she could ; she borrowed of her hosts some household utensils and purchased the provisions ; her kindly countenance, her affable politeness, made her to be welcomed (*bien venir*) by the shopkeepers' wives.

(ii.) The two women turned round (*se retourner*), uttering a cry of surprise, and perceived a stranger who had just turned the hedge near which they were seated ; he had heard the touching prayer of Paul, and approaching him, he took his head and turned the eyes towards the light, after having examined them.

(iii.) The prayer of each day uttered (*faire*) aloud had not taken place that day ; the mother was afraid she could not master (*maîtriser*) her emotion. Her trembling lips could not speak (*proférer*) the words whose sound came and died vaguely on her mouth.

(iv.) The impression these words made on the mother and daughter was unutterable (*indicible*). . . Both threw themselves on the child with a cry of love, their arms twined round the knees of the operator, and eloquent tears told their joy.

(v.) The learned and brave doctor kissed again and again (*à plusieurs reprises*) the joyous forehead of the child, grasped in his own the hands of the widow, kissed (use a different word this time) the fair locks of Marguerite, and said to them, 'I will come again.'

(vi.) He was a handsome old man ; his features were noble and strongly marked (*accentué*), intelligence and kindness reigned on his broad forehead, shaded by hair still black, parted on the top of the head and falling down in natural ringlets on to his shoulders. His large black eyes, keen and gentle, attracted confidence and affection ; his whole person in fact commanded respect.

HONOURS PHYSIOGRAPHY NOTES.

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THE UNIVERSAL DAY, AND THE ZONAL SYSTEM OF RECKONING TIME.

For some years past efforts have been made to establish a universal method of reckoning time, founded on a sound scientific basis. Ten years ago an International Conference, in which twenty-five nations were represented, was held at Washington for the purpose of fixing a prime meridian to be employed as a common zero of longitude and standard of time-reckoning throughout the globe. The following series of resolutions were then passed :—

(1) That it is the opinion of the congress that it is desirable to adopt a single prime meridian for all nations, in place of the multiplicity of meridians which now exist.

(2) That this Conference propose to the Governments here represented the adoption of the meridian passing through the centre of the transit instrument at the Observatory of Greenwich as the initial meridian for longitude.

(3) That from this meridian longitudes shall be counted in two directions up to 180 degrees, east longitude being plus, and west longitude minus.

(4) That the Conference proposes the adoption of a universal day for all purposes for which it may be found convenient, and which shall not interfere with the use of local or other standard time where desirable.

(5) That this universal day is to be a mean solar day ; is to begin for all the world at the moment of mean midnight of the initial meridian, coinciding with the beginning of the civil day and date of that meridian ; and is to be counted from zero up to twenty-four hours.

(6) That this Conference expresses the hope that as soon as may be practicable the astronomical and nautical days will be arranged everywhere to begin at mean midnight.

[It will be remembered that the astronomical day begins at mean noon, in this respect differing from the civil or ordinary day, which is reckoned from midnight to noon, and then from noon to midnight.]

(7) That this Conference expresses the hope that the technical studies designed to regulate and extend the application of the decimal system to the division of angular space and of time shall be resumed so as to permit the extension of this application to all cases in which it presents real advantages.

These suggestions will, in all probability, be accepted in the course of a few years, but the changes required are so great that there is little possibility of many nations abruptly altering their systems of time-reckoning in order to assist in the desired unification. The first important step towards the universal day certainly lies in the adoption of what is known as the 'Hour Zone System.' For the following description of this system we are indebted to a report drawn up by Dr. Sandford Fleming, who first urged its claims :—

'In the hour zone system the circumference of our globe is divided into twenty-four sections or zones. The central line of each zone is an hour meridian, and the hour meridians are fifteen degrees apart. The meridians are numbered in consecutive order towards the west from zero, the anti-prime meridian.

'The hour zones theoretically extend seven-and-a-half degrees of longitude on each side of the hour meridian, but in practice that is by no means an essential rule. The boundary line of contiguous zones may be governed by national, geographical, or commercial circumstances.

'As the earth rotates on its axis once in twenty-four hours, an hour elapses between the solar passage on each successive hour

meridian; it is obvious, therefore, that if the reckoning in each zone be governed by its respective meridian, the reckonings everywhere will be directly related. There will be differences, but the differences will in every case be known, and they will invariably be multiples of an hour. Throughout the globe there will be complete identity in the minutes and seconds. For example, when the reckoning in the tenth zone is six hours twenty-five minutes, in the eleventh zone it will be five hours twenty-five minutes, in the twelfth zone four hours twenty-five minutes, and so on, each successive zone differing by an exact hour. Thus the only departure from complete uniformity of reckoning around the globe will be in the numbers of the hours, but the numbers of the hours being governed by the numbers of the hour meridians, the passage to universal time is simple and direct.'

The hour zone system thus forms an easy means of transition from old to new ideas, and by adopting hour meridians as local standards for reckoning, grave difficulties in the way of accepting universal time are to a large measure overcome without any violent departure from prevailing customs. When the hour meridians have been generally accepted as the meridians from which to reckon local time in the various regions of the world, we shall be in a fair way to having universal time. The old system of using meridians passing through certain capitals and towns irregularly scattered over the earth, as the prime meridians of the different countries to whom the places belong, is gradually giving place to the system of using a convenient hour meridian as the line of reference. The designation of the hour meridians has raised little difficulties. It is important, as Dr. Sandford Fleming points out, that a nomenclature be adopted which will obviate all confusion and give the greatest satisfaction in future years in all quarters of the globe. In Europe three hour meridians are in use—viz., the one passing through Greenwich, the meridian 15° or one hour to the west of it, and that 30° or two hours to the east of it. There are thus three European times, and they are known respectively as the time of Western Europe (Greenwich time); the time of Eastern Europe (which differs by only one minute from St. Petersburg time); and the time of Central Europe. It was originally proposed that each hour meridian should be distinguished by numbers, not by names based on local and geographical terms, but this principle has not been generally adopted.

Among other reasons why the meridians should be distinguished by numbers, Dr. Sandford Fleming gives the following :—

(1) The twenty-four hour meridians take their origin from the recognised zero of time, which is diurnally determined by the solar passage on the anti-prime meridian (that is, the meridian 180° from Greenwich); it is therefore natural that if they are to be known by numbers, the series of numbers should begin at the anti-prime meridian as zero.

(2) If we commence to observe the passage of time at the instant of zero, in an hour the earth will have revolved on its axis fifteen degrees and brought up the first hour meridian west of the anti-prime meridian under the sun. What more appropriate designation for this hour meridian than number one (*unus*)? At the end of the second hour the earth will have revolved another fifteen degrees, and brought under the sun the second hour meridian west of the anti-

prime meridian. With equal propriety this may be termed hour meridian number two (*duo*); similarly the third, fourth, and every one of the twenty-four hour meridians may be numbered in consecutive order. This mode of distinguishing the hour meridians is not only characterised by simplicity, but is also convenient. Referring to the accompanying projection of the northern hemisphere, the figures around the circumference indicate the hour meridians numbered on this principle. These figures likewise indicate the twenty-four hours into which the world's standard unit measure of time is divided. The motion of the earth on its axis brings each hour meridian in succession to its solar passage, and by numbering them as described a complete coincidence is obtained between the hour meridians and the hours of the world's standard. For example, when the solar passage is on the hour meridian number twelve it will be twelve o'clock (universal time), when on hour meridian number seventeen it will be 17 o'clock (universal time), and so on for every meridian. Thus we realise the conception that the earth itself is the great standard chronometer, while the sun is the index to point out the hours.

We have given an extended description of the hour zone system, because, though it has been adopted in a number of countries, information upon it cannot be found in many books, and it has been the chief purpose of the authors of these notes to supply such deficiencies.

From the February number of the Monthly Notices of the Royal Astronomical Society it appears that during the past year some progress has been made with the project for adopting a zonal system of time on the Continent. On April 1st Germany adopted mid-European time, one hour fast on Greenwich, as the legal standard time for the Empire. On November 1st the same system was adopted in Italy, and from the first day of the current year mid-European time has been in use in Denmark. A law also has been passed in Switzerland authorising the use of this time throughout the country from June 1st next. A bill with a similar object was introduced in the Austrian Reichsrath, but there is at present no information as to its having been passed.

The following table gives the present position of affairs :—

Country.	Standard Time.
England, Belgium, Holland	Greenwich Time.
Denmark, Germany, Italy, Switzerland*, Norway and Sweden	1 hour fast on Greenwich Time.
Japan, Australia	9 hours fast on Greenwich Time.
United States and Canada	4, 5, 6, 7 or 8 hours slow on Greenwich Time, according to longitude.

At the time when the standard time was changed in Italy the twenty-four hours system of reckoning was also introduced, 0 hours being midnight.

The Currents of the North American Lakes.

Nature has just published (April 19th), a description of the currents in the great lakes of North America, based upon a report drawn up by Prof. Mark W. Harrington, chief of the U.S. Weather Bureau. The following extracts from the summary are both interesting and important :—

The method of observation was by bottle-papers, which have frequently been used to study ocean currents, but had not been employed in the lakes, and is as follows :—A bottle containing a paper, on which is written the time and place of floating, is thrown overboard at some definite point, left to float freely, and when picked up the enclosed paper is marked with the time and place of finding. In this way two points in the line of current are obtained, and by considering a very large number of these, satisfactory conclusions can be drawn as to the currents which convey the bottle.

The bottles actually picked up were for the most part on shore, very few of them having been found in the water. It is impossible to say what proportion of the bottles was recovered, but it was not great. Though probably more than five per cent., it did not exceed ten per cent. The figures cannot be given exactly, because it is not known how many of the bottles are still in the hands of masters of vessels. A considerable portion of the papers recovered was found on the Canadian shores, and curiously a large number of them came from shores which are for the most part uninhabited.

The investigation covers the year 1892 and 1893, but it must be remembered that the observations could be taken only during the season of navigation. This practically limits the conclusions to the summer months, as when the bottles are floated in the spring they will probably be found in the autumn, and those which are floated

* From 1st of next June.

in the autumn will be lodged in ice, and their routes be variously changed, so that trustworthy conclusions cannot be drawn from them.

The directions of currents can be ascertained with much more precision by means of bottle-papers than can the velocities. It has therefore been very difficult to arrive at any satisfactory conclusions concerning the speed of the currents in the Great Lakes. In a general way, the speed appears to vary from four to twelve miles a day. In a few special cases, very much higher velocities have been found, but these are probably due to surf motion rather than the motion of the surface water as a whole. It is not at all improbable that the general surface motion of the lakes has a higher velocity than from four to twelve miles a day, but the only conclusion which it seems safe to draw from the data is that the velocities are at least as high as the figures mentioned.

From the courses of the bottles in Lake Superior, it appears that there is a general surface current along the south shore, from the Apostle Islands eastward, and that to the east of Keweenaw Point this eastern current has very great breadth. Still further eastward, toward the eastern end of the lake, it spreads out in a fan-shaped way, and a branch of it seems to pass to the northward and westward, reaching the extreme northern coast of the lake. A branch of this current also turns southerly round Keweenaw Point, and at the bottom of the bay, on the south coast of the lake, an eastern current is taken up, which joins the main current to the eastward of Marquette, Michigan. The minimum velocity of the main eastward current of the lake appears to be from four to six miles a day.

The currents indicated by the floating of the bottles in Lake Michigan are of unusual interest. There is first a strong and well-marked current up the eastern coast, passing between the Maniton Islands and the Michigan mainland, and ending in the reefs and rocks to the north of Little Traverse Bay. There is a current down the west coast, but at some distance off-shore. In the space between its margin and the shore there are varying currents, sometimes to the northward and sometimes to the southward—on the whole rather from the south than from the north. There is a great but gentle whirl about Beaver Island in a direction contrary to the hands of a watch. The velocities found in these currents are greater than those found in Lake Superior, and this is especially true of the northern end of the current, which passes up along the east coast. In the case of the bottles which crossed Lake Michigan, the velocities obtained in the best cases varied from four to four and a half miles a day. Taking only the bottles which passed between Maniton Islands and the mainland, the velocities obtained varied from six and a half to ten a day.

From the courses of the bottles, it is concluded that the arrangement of currents in Lake Huron is very much like that of Lake Michigan. In this case, however, it seems that the main current is along the west coast, while in Lake Michigan it is along the east coast. It is found that in Lake Huron there is a strong current passing down the west coast and some little distance out, the whole length of the lake, turning on itself near the point of the lake, and passing up the east coast, possibly turning again along the north shore and rejoining the other current in the vicinity of Bois Blanc Island. A branch of this return extends into Georgian Bay.

The general course of the bottles in Lake Erie was eastward along the axis of the lake, with a tendency from point to point toward the coast. The indications are that the main current along the axis is best developed at no great distance from the south coast, and much farther from the north coast, which is cut by two long points extending out to about one-third of its width.

The directions taken by the bottles in Lake Ontario are somewhat similar to those in Lake Erie, but quite distinct from those of the upper lakes. There is a general current extending diagonally across the lake from opposite the mouth of Niagara River to the outlet near Kingston. The bottles exhibited a strong tendency to seek the east coast, passing down into the bay on which Sacketts Harbour, N.Y., is situated. There are evidences of a whirl in the western end of the lake, west of the meridian of Toronto.

The Dynamics of the Atmosphere.

With regard to this matter we cannot do better than give the following passages from a contribution by Werner Von Siemens to the *Meterologische Zeitschrift*, of which a translation appeared in a recent report of the Smithsonian Institute (U.S.A.) :—

'I pass now to an assumption of Ferrel's with which I cannot bring myself to agree. It is this, that on an inclined surface of equal air pressure there can be a descent of the overlying air layers. It is just as impossible that there should be an impulse to tangential displacement on sloping isobaric surfaces as in the case of level surfaces. That such a displacement could not possibly exist is evident at once from the consideration that a descending stream of air, in case it actually begins at any time, must immediately develop a change of pressure destroying the equilibrium, and must at once produce a return current. *It results from this that a continuously progressive heating of the atmosphere, such as in reality (aside from disturbances) takes place from the polar regions down to the equator, furnishes no possibility for a meridional circulation such as Dove has assumed.* It is possible, in such an unequally heated atmosphere, to draw at all heights isobaric surfaces extending from the equator to the poles, on which no air motion can originate.

'In spite of the great rarefaction by the heat of the torrid zone, the atmosphere would nevertheless remain at rest if no disturbance of the neutral equilibrium took place in any part of it. Apart from all friction, no expenditure of work is required to bring a mass of air from one height in a column to another ; if the mass is removed to a higher level the energy consumed in the expansion of the air under diminished pressure finds its equivalent in the loss of heat by cooling, and there is no disengagement of energy into or absorption from adjacent masses. The general prevalence of neutral equilibrium in the atmosphere is therefore the cause of its state of relative rest, and every disturbance of this equilibrium is of the nature of an accumulation of energy, and has a tendency to cause currents in the air and thus to restore the condition of neutral equilibrium. The origin of these disturbances is to be sought exclusively in the unequal heating of the air strata by solar radiation, and in their unequal cooling by the radiation of heat into space. The solar radiation especially heats the earth's surface, and by means of this the lower air layers contiguous thereto. The excess of temperature thereby produced above the ground temperature, due to the superincumbent pressure (which latter corresponds to the average heating of the whole overlying air column), constitutes an accumulation of free energy, like that of a stretched spring, which can be brought into equilibrium again only by such a diffusion of the existing excess of temperature of the lowest strata upward through the entire overlying air column as shall restore the disturbed equilibrium.

'Practically this can only be done by means of air currents. In the case of a locally restricted overheating there will originate at any favourable place a bulging upward of the overheated air, which then increases rapidly in height, since the upward thrust increases at a rate proportional to the height of the natural chimney thus formed, and the diminished pressure resisting it. But apart from its height this chimney is to be essentially distinguished from an ordinary one by the fact that it has elastic walls, and that the pressure and density of the air strata inside, as well as outside of it, diminish with height. Thus the air velocity during the up-rush increases in an inverse ratio to the density, since in every minute of time an equally great mass of air must pass through every section of the chimney. Since, in consideration of the small height of the atmosphere as compared with the earth's radius, no increase of volume with the height, due to the increasing area of a sphere as one travels outward from the centre, need be taken into consideration, therefore, in general, the velocity of the air currents in ascending and descending must decrease and increase with the prevailing air pressure at each level.

'Hence, also, in the case of an up-rush of air, more of the solar energy accumulated in it is transformed into the *vis viva* of moving masses of air than would be the case without this acceleration due to upward diminishing density.

'To summarise. In the case of an up-rush of a limited mass of air overheated at the ground, the final result is a local up-rush with accelerated velocity up to the higher, and even the highest, air regions, and simultaneously a descent of the air strata surrounding the upward currents, with a velocity diminishing during the descent, and finally a diffusion of the heat accumulated at the earth's surface to all the overlying air strata, with a restoration of the disturbed neutral equilibrium of this part of the atmosphere.

'In essentially the same manner, but in its outward manifestation very differently, this restoration of the neutral equilibrium disturbed by solar radiation takes place when the overheating of the air strata adjacent to the ground extends over an entire zone of the earth. In this case the up-rush can no longer be locally restricted, but must systematically surround the whole torrid zone. Neither can it be limited as to time, but the process of adjustment must continue just as long as the causes of disturbance. There must therefore originate a circulatory system embracing the whole atmosphere, which finally performs the task of distributing the excessive heat of the air strata adjacent to the ground in the torrid zone.'

The theory of the general circulation of the atmosphere may be summed up in the following principles :—

'(1) All motions of the air originate in disturbances of the neutral equilibrium of the atmosphere, and serve the purpose of restoring it.

'(2) These disturbances are brought about through overheating of the strata of air lying next to the earth's surface by solar radiation,

by unsymmetrical cooling of the higher strata by radiation, and by backing up the moving masses of air in case of the occurrence of resistances to the current.

'(3) The disturbances are compensated by rising air currents having an acceleration of such magnitude that the increase of velocity is proportional to the decrease of air pressure.

'(4) Corresponding to the upward currents are equally great downward currents in which a diminution of velocity occurs comparable with the acceleration in the case of the rising current.

'(5) If the region of the overheating of the lower air is a restricted one, a local up-draft sets in which extends up to the highest part of the atmosphere, and presents the phenomena of whirl pillars, whose interior consists of spirally ascending currents, and whose exterior is made up of similar spiral air currents directed downward. The result of these vortex currents is to diffuse the surplus heat of the lower air by which the equilibrium was destroyed throughout all the overlying air columns which take part in the vortex motion.

'(6) In case the region of disturbance of neutral (or adiabatic) equilibrium is very extended, so as, for example, to embrace the whole torrid zone, then the equalization of temperature no longer takes place by means of locally uprising vortex currents. Instead, currents must form and encompass the whole atmosphere.

'The conditions of accelerated uprise and of retarded downflow laid down for the local whirl still hold good, so that the velocity of the air motion at different heights, developed by the energy of heat, is increased approximately in proportion to the air pressure there prevailing.

'(7) Since the whole atmosphere (in consequence of the continuous meridional circulation set up and maintained by the energy of heat) must rotate at all latitudes with approximately the same absolute velocity, the meridional currents produced by overheating unite with the terrestrial current in the great system of atmospheric circulation embracing the whole earth. This circulation serves the purpose of diffusing upwards through the whole atmosphere the excessive heat of the torrid zone, of carrying this equatorial heat and humidity to middle and high latitudes, and of bringing about the development of local air currents at those parallels.

'(8) The latter phenomena take place as a result of the production of alternating local increments and decrements of air pressure arising from the disturbance of neutral equilibrium in the higher strata of the atmosphere.

'9. Areas of high and low pressure are consequences of the temperature and velocity of the air currents in the higher strata of the atmosphere. This temperature and velocity will depend upon the place of up-rush and the season of the year.'

A Foucault's Pendulum Difficulty.

A correspondent (G.A.M.) writes from Ryde asking for an explanation of the following paragraph in Gregory's 'Elementary Physiography' (p. 122). The italics are his own.

'Such a pendulum [referring to Pendulum Exp.—Rotation of Earth] suspended at either of the poles would appear to describe a circle in 23 hrs. 56 mins. 4 secs., which we have seen is a sidereal day, or the true time of rotation of earth. As we move from poles to equator, the time taken for the pendulum to describe the circle increases, *and at the equator no such motion is observed, the pendulum taking there an infinitely long time to complete the circle of vibrations.*'

It will not be necessary for us to give a detailed explanation of the conditions of the motion of Foucault's pendulum in different latitudes. Students who desire to thoroughly understand the mathematics of the matter, may refer to Sir John Herschel's 'Outlines of Astronomy,' pp. 156–159, or Young's 'General Astronomy,' §§ 140, 141, or Barlow and Bryan's 'Mathematical Astronomy,' pp. 318–320. The first thing to be borne in mind is that the pendulum oscillates to and fro as if it were suspended from a point in space entirely unconnected with the earth. This end is gained by using a very heavy ball suspended by a long wire in a particular manner. When the ball is set oscillating, it tends to keep in one plane of movement, and considerable force is required to move it out of that plane. To concentrate the mind, suppose the ball to oscillate to and fro over a line on a table at the north pole. The table is twisted round once a day on account of the earth's rotation, but the plane of oscillation of the pendulum remains fixed all the time. To the polar observer, however, it would appear as if the plane of oscillation really had its direction changed, while the table remained fixed. But whichever is considered to move, the angle between the direction of oscillation and the line on the table would increase at the rate of 15° (roughly) per hour. Now let the pendulum and the table be taken to the equator, and suppose first that the line over which the pendulum is started on the table lies in the plane of the equator. The table is carried round by the earth's rotation, but it is not twisted, and the line upon it always lies in the equatorial plane. The pendulum keeps to its plane of oscillation as heretofore; hence, as it was started over the line on the table, it continues to go to and fro above the line so long as it has any motion at all. The hourly motion of the plane of oscillation is therefore *nil*, and this fact is expresssed in the offending paragraph (not too happily, perhaps,) by saying that the pendulum takes an infinitely long time to complete the circle of vibrations. Probably a better way of putting the point is to say that it takes an infinitely long time for the plane of oscillation and the plane of starting of the pendulum to vary by 360°, which is another way of saying that there is no change at all. Even if the line on the table is supposed to lie at right angles to the equator, and the pendulum to be started over it, there can be no change between the two directions; for though the table is carried round with the earth, it is not twisted under the pendulum. Now suppose the pendulum is not oscillating north and south, nor east and west, but in an intermediate direction. Half of its motion then takes place north of the equator, and half south of it; that is to say, a complete oscillation of the pendulum consists of a movement from the position of rest to a certain distance north, then back to this position, to swing for the same distance south of the equator, and back again. When north of the equator, the plane of oscillation has a tendency to move round relative to the table in the opposite direction to the hands of a clock; but when south, the tendency is apparently to turn the plane round in the reverse way. The two effects thus counteract one another, and, therefore, the plane of oscillation never changes its direction with respect to the table. The case of an intermediate latitude is more complicated. Suffice it to say that the angular motion of the plane of oscillation per hour decreases from the poles to the equator. At Aberdeen (latitude 57°) the hourly change in direction of this plane is nearly 13°; at Ceylon (latitude 7°) the hourly motion is less than 2°. If l be taken to represent the latitude, then the motion per sidereal hour is 15° sin l, and the time required to make a complete rotation is equal to cosec l sidereal days. Students of trigonometry will remember that the cosecant of 0° is ∞ (infinity), and knowing this, they will have no difficulty in understanding that at the equator, that is when $l = 0°$, the period of a Foucault's pendulum is infinitely long.

The Protective Influence of Atmospheric Moisture.

Lord Kelvin some years since pointed out an error of Professor Tyndall's that is still to be found in many elementary works. It is stated that the retention of heat by the earth's surface at night is due to the *absorption* of radiation by water vapour in the strata of the atmosphere. Clouds being bodies opaque to radiant heat as well as to light, do of course intercept and radiate back to earth a considerable part of its heat, but when the sky is clear Lord Kelvin states that very little of the heat passing into space is caught by the air and retained. Yet unless the waste of warmth that must occur on this supposition is made up to some extent, there would be a severe frost every night in the year. How is this loss made good? By the latent heat of vaporization, which is disengaged when dew is precipitated. On a clear night the temperature of the earth's surface falls rapidly to the dew point, but it cannot fall below that point. The dew point itself of course may drop as moisture is withdrawn from the air; that is a different matter altogether. If the air were absolutely dry, then there would be no clouds and no dew point, and the earth's temperature would continue to fall rapidly throughout the night to points far below the present minima.

Subdivision of Pre-Cambrian Rocks.

In the new *Journal of Geology* (Chicago) is a paper by Sir Archibald Geikie, in which he discusses the pre-Cambrian rocks of the British Isles in general terms. He is of opinion that the Scotch development of these rocks falls into two series: the lowest a series of coarse gneisses (the gneiss structure of these being, in his opinion, not a metamorphic, but an original structure 'due to a process of separation that went on while the igneous magma was still in a liquid or viscous condition'), and which he proposes to call the *Lewisian gneiss*; and (ii.) a series of stratified derived rocks above these, the *Torridonian series*, chiefly of purple-red sandstone, often with bands of conglomerate, and with dark grey shales at the base and the upper horizons. These shales appear to be non-fossiliferous, with the exception of doubtful annelid tracks, and certain 'nail-like bodies which may have been organic.' He correlates the Lewisian series to certain English Archaens, notably those of Anglesey. But in the absence of fossils the identification of rock formations over large areas becomes, of course, an extremely hazardous proceeding. The Torridonian series is not so certainly represented in the English exposures.

For announcement of Mr. Gregory's Geographical Works, see page 3 of wrapper.

OUR PUPIL TEACHERS' COURSE.

I.—SCHOOL MANAGEMENT.

Despite the assertions of the Right Hon. Robert Lowe, and of a live Scotch Professor, there is a 'Science of Education' which we are thankful to say our Whitehall guardians are bearing increasingly in remembrance.

Until a very few years ago, Pupil-Teachers had no special paper upon School-Management, but an odd question or two invariably of the 'Notes of Lesson' kind was thrown in with the Geography, or as a subject of Composition.

A.—Thus **Second Years** had Notes of Lessons on—

(1) New Zealand (January, 1881), (October, 1882), (January, 1883).
(2) Jamaica. (October, 1881.)
(3) Productions and Trade of Hindostan. (November, 1881.)
(4) Malt and Hops (Composition). ,,
(5) Climate and Productions of British North America. (January, 1882.)
(6) Simple Geometrical Forms (Composition). (January, 1882.)
(7) Glass (Composition). (February, 1882.)
(8) Malta. (March 1882), (November, 1882).
(9) Metals (Composition). (March, 1882.)
(10) The Life of an Australian Settler. (April, 1882.)
(11) Wheat (Composition). ,,
(12) Mountain Ranges under the heads of (*a*) What is a *mountain?* (*b*) What is a *range?* (*c*) What is meant by '*the line of perpetual snow*,' and what is the cause of it? (*d*) How do mountains form *boundaries* and *watersheds?* (*e*) Why do great rivers generally rise in mountains? (May, 1882.)
(13) Leather and its uses (Composition). ,,
(14) St. Lawrence and its Lakes. (June, 1882.)
(15) A Farm (Composition). ,,
(16) The British Colonies. (August and September, 1882.)
(17) Bread (Composition). (August, 1882.)
(18) Slate ,, (September, 1882.)
(19) The Oak ,, (October, 1882), (November).
(20) Paper ,, (January, 1883.)

B.—Thus **Third Years** had Notes of Lessons on—

(1) The Caspian Sea. (November, 1881.)
(2) Isthmus of Suez and Red Sea. (January, 1882.)
(3) Journey to India by Suez Canal. (March, 1882.)
(4) ,, from Cape Town to Dieppe viâ Suez Canal, Brindisi, and Paris. (April, 1882.)
(5) Mountains and Rivers of Hindostan. (May, 1882.)
(6) St. Lawrence and its Lakes. (June, 1882.)
(7) Coasting Voyage from Athens to Alexandria. (August, 1882.)
(8) Our African Possessions. (September, 1882.)
(9) Caspian Sea. (October, 1882.)
(10) Japan and its People. (November, 1882.)
(11) Physical Features of Africa. (January, 1883.)

Our readers will see at once that questions confined to Notes of Lessons on Geography could not afford adequate data for Third Year School-Management marks, and that in setting for Second Year Notes of Lessons for the Composition exercise, either the Composition or School-Management must suffer.

But *nous avons changé tout cela;* we will take a leap to 1889, when wiser counsels and fuller knowledge ruled.

C.—**First Years** have no paper work in School-Management except that their papers on arithmetic may contain questions requiring the several rules to be explained and demonstrated as to a class of scholars. The following have been given :—

(1) Prove that $\frac{3}{4} = \frac{9}{12}$. (*Girls*, April, 1889), (*Boys*, October, 1889), (*Girls*, October, 1893).
(2) *Prove* that $\frac{2}{3}$ of $1\frac{1}{2} = \frac{3}{4}$. (*Boys*, April, 1889.)
(3) Find G.C.M. of 17,822 and 17,803, and *prove* it is the G.C.M. (*Boys*, October, 1889), (*Boys*, April, 1890).
(4) Prove the rule for pointing in multiplication of decimals. (*Boys*, April, 1890.)
(5) Show by a diagram that the value of a fraction is not altered by multiplying the numerator and denominator by the same quantity. (*Girls*, October, 1891.)
(6) If a Vulgar Fraction in its lowest terms can be represented by a terminating decimal, the factors of its denomination must be powers of 2 or 5. *Prove* this. (*Boys*, October, 1891.)
(7) Why must the addition of fractions with different denominators be effected by reducing each of the fractions to a common denominator? (*Boys*, April, 1892.)
(8) *Prove* by a diagram that $\frac{5}{8} + \frac{3}{4} = 1\frac{7}{12}$. (*Girls*, October, 1893.)

Questions are also occasionally given respecting Prime Numbers and the tests of divisibility.

D.—**Second Years** are given in the Arithmetical paper a considerable number of terms to explain, but very little attention is paid therein to proofs of rules and methods of teaching.

The *Teaching Paper* proper runs on the following lines :—

i.—*Reading*—

(1) It is said that some children know their reading-books almost by heart, and that when examined they only recite, not read. How could you detect this fault, and by what means guard against it? (October, 1889.)
(2) What sort of reading-lessons have you found most interesting to young children? Describe the way in which you would try to secure distinct articulation. (April, 1890.)
(3) Name a few words which, owing to the presence of *silent* letters, are especially difficult for young children to read. (October, 1890.)
(4) Explain the use which a teacher should make of simultaneous, and of pattern reading. Say what objection (if any) there is to an excessive use of either method. (April, 1892.)
(5) In teaching the elements of reading to young children, say whether it is better to begin with little words, and afterwards call attention to the letters, or to begin with the alphabet, and afterwards make up simple words? Give your reasons. (October, 1892.)
(6) What are the commonest faults in children's reading, and how may they be best rectified or prevented? (April, 1893.)

ii.—*Spelling and Dictation*—

(1) Take the following words, and give a list of others which might be grouped with them for a spelling lesson :—*Rough, should, which, many, taught.* (October, 1890.)
(2) Name eight words in the spelling of which young children often make mistakes, and explain by what sort of exercises such mistakes may be avoided or corrected. (April, 1891.)
(3) What rules is it necessary to observe in giving out and correcting a Dictation lesson? (October, 1893.)

iii.—*Writing*—

(1) What is the use of *tracing* in the earlier copy-book exercises? What are the objections, if any, to the practice? (October, 1889.)
(2) Arrange the letters of the alphabet in the order of their difficulty for the teaching of writing. Show how you would group the easiest of them for lessons to young beginners. (April, 1890.)
(3) Write as a largehand copy the words '*Geometrical Drawing*,' and point out which of the letters is likely to present special difficulties to a young scholar. What rules should be observed in forming such letters? (April, 1891.)
(4) Show what kind of ruling in the slates and copy-books of the younger children is best suited to teach the proper forms and proportions of letters. Give illustrations. (April, 1892.)
(5) Write six capital letters in such a way as to show the proper forms and proportions of their parts, and say how you would give a lesson on them. (October, 1892.)

iv.—*Arithmetic*—

(1) Make some mental exercises on *money* suited for the First and Second Standards, and let them be as varied in form as possible. (October, 1889.)
(2) Say how you would explain to beginners the rule for subtraction, and illustrate your answer by this example :—806 *minus* 527. (April, 1890.)
(3) Take the following sum in Long Division, and work it so as to show fully the value of each separate figure in the answer and of each remainder :—£72,185 13s. 2d. ÷ 163. (October, 1890.)
(4) Give as many forms of mental exercises as you can on the number 24. (April, 1892.)
(5) Explain what is the proper use of a ball frame or counting frame in teaching Arithmetic. Suppose you had no such apparatus, explain how you might teach counting by any of the objects in the schoolroom. (October, 1892.)
(6) Suppose you had to give a first lesson on Fractional Arithmetic, what visible illustrations would it be well to use? Show also what sort of easy *mental* exercises ought to precede a formal lesson on this subject. (April, 1893.)
(7) What is the use of a '*problem*' as an exercise in Arithmetic? Frame two questions containing a problem for *each* of these three standards—third, fourth, fifth. (October, 1893.)

v.—*Miscellaneous*—

(1) What are the '*Elementary Subjects*' recognised in the Code, and why are they so-called? State the requirements for the first, third, and fifth standards respectively. (April, 1893.)

(2) '*For Infants.*'—Name the manual employments most interesting to little children, and explain the way to conduct an exercise in one of them. (October, 1893.)

Third Years have recently had the following queries in their Arithmetical Paper.

(1) Explain the rule for finding the square root of a number of four digits by an algebraical illustration. (*Boys*, April, 1890.)

(2) Prove that a fraction is divided by a whole number when its denominator is multiplied by that number. (*Boys*, April, 1892.)

(3) Show that the value of a fraction is not altered by multiplying numerator and denominator by the same number. (*Boys*, October, 1892.)

(4) Prove that if a Vulgar Fraction in its lowest terms be equivalent to a terminating decimal, the denominator of that fraction can only contain the prime numbers 2 and 5. (*Boys*, October, 1893.)

(5) Prove that no number terminating in 2, 8, 3, or 7 can be a perfect square. (*Boys*, October, 1893.)

(6) Explain how you would give a first lesson to children on proportion. (*Girls*, October, 1892.)

(7) When is a fraction said to be in its lowest terms? (*Girls*, October, 1893.)

(8) Give a rule for division of decimals which shall include all cases of division, and explain why the division of one decimal by another, each fraction being less than unity, may give an integral quotient. (*Girls*, October, 1893.)

In the ordinary 'Teaching' paper the subjoined are the principal queries :—

i.—*Reading*—

(1) What is meant by '*Simultaneous Reading*'? How should it be conducted, and what is the use of it? (April, 1890.)

(2) What is meant by '*tone*,' '*accent*,' '*emphasis*,' and '*expression*' in Reading? Say why they need special attention, and how you can best deal with them. (October, 1890.)

(3) Describe your own practice in explaining the meanings of words which occur in a Reading lesson. Is it better to give needful explanations in the course of the lesson or to reserve them to the end? Give your reasons, and say whether you prefer dictionary definitions of *words*, or brief paraphrases of clauses and sentences, and why? (April, 1893), (October, 1893).

ii.—*Arithmetic*—

(1) Describe the best system you know for teaching Numeration and Notation. (April, 1890.)

(2) The New Code requires an exercise in '*Rapid Addition*.' Make out a column of figures suited for this exercise, and say how you would best secure quickness and accuracy in performing it. (October, 1890.)

(3) Write out four simple problems in Arithmetic, such as would be suitable in the Fourth Standard for testing the intelligence with which the scholars had learnt the rules. (April, 1891.)

(4) Make up half-a-dozen good testing questions in Arithmetic for scholars who have been a year in Standard IV., and are supposed to be ready for promotion to the Fifth Standard. (October, 1892.)

(5) Make four sums—two in direct and two in inverse proportion, and show how you would explain to a class the working of one of them. (April, 1890.)

iii.—*Grammar*—

(1) In teaching Grammar, say in what order you would take the several parts of speech, and give your reasons. Which should be taken first, the *examples* or the *definitions*, and why? (October, 1892.)

iv.—*Geography*—

(1) What is the meaning of the distinction between *Physical*, *Political*, *Mathematical*, and *Industrial* Geography? Say which of these should be first taught, and why? (April, 1891.)

(2) What is the difference between *Physical*, *Mathematical*, *Commercial*, and *Political* Geography? Illustrate your answer by arraying a few facts under each of these heads, in reference to some country of which you have recently learned most. (April, 1893.)

(3) Describe a good course of Geography lessons from the Third to the Sixth Standard. Say how far you would rely upon *oral teaching*, and how far on *book work* in making such a course effective. (October, 1893.)

v.—*Miscellaneous*—

(1) What are the '*Class Subjects*' mentioned in the Code? If you had to teach any one of them, say how far you would rely on *Reading Books*, and how far on *oral lessons*. (April, 1892.)

(2) Say what are the best means of rousing and sustaining the attention of a class inclined to be disorderly. (April, 1892.)

(3) Supposing you were criticising an *object lesson* given by another teacher, under what heads would you arrange your criticisms, and what tests would you apply in order to judge whether the lesson was successful or not? (October, 1892.)

vi.—*Notes of Lessons.*

(α) *Arithmetic.*

(1) Reduction of Money. (April, 1890.)
(2) Ratio. (April, 1891.)
(3) Ratio and Proportion. (April, 1893.)

(β) *English*—

(1) The Adjective and its uses. (October, 1890.)
(2) Adjective Sentences. (April, 1892.)
(3) The Predicate of a Sentence. (April, 1893.)
(4) The Analysis of a Sentence. (October, 1893.)

(γ) *Geography*—

(1) Climate. (April, 1890.)
(2) A Commercial Port. (April, 1890.)
(3) Winds. (October, 1890.)
(4) English Cathedrals. (April, 1891.)
(5) The Alps. (April, 1892.)
(6) Mountains. (October, 1892.)

(δ) *Miscellaneous*—

(1) The Sun. (October, 1890.)
(2) The House of Commons. (October, 1892.)
(3) The Uses of the Electric Telegraph. (October, 1892.)
(4) The Use of Laws. (April, 1893.)
(5) The Iron Manufacture. (October, 1893.)
(6) A Pump. (October, 1893.)

(ε) *For Infants*—

(1) Water and its Uses. (April, 1890.)
(2) Leaves of Trees. (October, 1890.)
(3) Bees. (April, 1891.)
(4) A Candle. (April, 1892.)
(5) The Primary Colours. (October, 1892.)
(6) Birds' Feathers. (April, 1893.)
(7) One of Froebel's Gifts. (April, 1893.)
(8) Rain and its Uses. (October, 1893.)
(9) The number nine. (October, 1893.)

(10) Describe the best system you know for teaching *Form and Colour*. (April, 1890.)

II.—Schedule V.

It is extremely probable that the alteration in the Pupil Teacher curriculum will not affect October's examination, but will come into examinational vogue in 1895. We shall thus in our Routines and Questions have to cater for two classes of Pupil Teachers, viz., those examined in October and April—at least as far as Geography and History are concerned.

III.—Text-Books for Pupil-Teachers.

Miscellaneous.—Heller's Code, Stormonth's Dictionary, Dunstan's 'Teacher's Manual of Music,' Hughes's 'Pupil Teacher's Copy Book,' Hughes's 'Art of Handwriting,' Halford-Hawkins' 'Art of Reading and Recitation,' Hughes's 'Constitutional Reader.'

School Management.—Flux's 'Scholarship School Management.'

Geography.—Gregory's 'Physical and Astronomical Geography,' Gregory's 'Physiography,' Brook's 'Geography,' W. and A. K. Johnston's 'Multum in Parvo' Atlas, Hughes's 'How to draw a Map,' and Blanchard's 'Geographical Notabilia,' Parts I. and II.

History.—Boyd-Carpenter and Green's 'British History,' Boyd-Carpenter and Green's 'Main Facts and Dates of British History,' W. and A. K. Johnston's 'Historical Atlas.'

English.—Dr. Beach's 'Elements of English,' Dawson's 'Paraphrasing,' Nelson's 'Lives of English Authors.'

Arithmetic.—Wollman's 'Teachers' Arithmetic,' Dixon and Beach's 'Arithmetic,' Wollman's 'Metric System.'

Mensuration.—Todhunter's.

Domestic Economy.—Hughes's 'Domestic Economy,' Mrs. Beach's 'Domestic Economy,' Parts I., II., III.

Euclid.—Deighton's; Egan's 'Exercises,' Part I.

The above works are undoubtedly the cheapest and best. They may be readily obtained from any scholastic stationer.

IV.—Recitation.

By request we give a greater choice than heretofore :—

First Year. 'The Lighthouse,' Longfellow, 56 lines.
'Night Thoughts,' Young, 67 lines (the first).
'Ode to Duty,' Wordsworth, 56 lines.

Second Year. 'The Cloud,' Shelley, 84 lines.
'Childe Harold' (Stanzas 177 to 185), Byron, 81 lines.
'Parrhasius' (The Victim), Willis, 90 lines.

Third Year. 'Alexander's Feast,' Dryden, 106 lines.
'My Mother's Picture,' Cowper, 121 lines.
'St. Cecilia's Day,' Pope, 134 lines.

Fourth Year. See 'Scholarship' article.

Recitation is often deferred to the last, to its great detriment, to its impotent rendering, and to the procrastinator's loss of marks.

From the very commencement of the School Year, First Year should learn 6 lines per week, Second Year 8 lines per week, Third Year 10 lines per week, till all be fulfilled.

Then it should be study as regards (*a*) its metrical structure, (*b*) its style, (*c*) its vocabulary, (*d*) its grammatical structure, and (*e*) its allusions.

The analysis of every sentence, the parsing of every word, should be understood, and something should be known of the date of the poem, the circumstances of its composition, the life of its author, and parallel passages or sentiments in other poems. It should also be paraphrased throughout.

The scientific and artistic details being comprehended, the student must then proceed to the reproduction in the highest and most suitable style of the passage chosen.

Therein must be no place for mock-modesty or genuine diffidence. Of all beings, a Teacher (the man *par excellence* who is placed on a pinnacle to instruct his fellows) must be able to give his reasons for the hope that is in him, for his opinions, and often for his conduct.

This must be done in the best way possible, and with all the accessories that knowledge, skill, and practice can concentrate into the forms of persuasiveness.

To this end, therefore, Recitation must tend, and the style of rendering must suit the extract. The manner must vary from conversation to declamation, from lively to severe, and must harmonise with the thought. Where the ideas are sublime, both

'The line should labour and the verse be slow,'

and the voice and manner be attempered to the poem.

Similarly when the conception is lively and graceful, and

'The frolicsome measure in merriment moves,'

must the tones and gestures correspond.

Every Pupil Teacher should read Pope's 'Essay on Criticism.'

To follow out these principles successfully much *vivâ voce* practice is required.

V.—Drawing and Science.

(*a*.) Each year, until all the Drawing Certificates are obtained, two subjects should be taken, Perspective and Model being the two last to be attempted.

(*b*.) During the First and Second years of apprenticeship a first-class in Second Grade Mathematics should be obtained by boys, and a first-class elementary by both sexes in one of the following sciences :—

i. (*a*.) Mechanics of Solids.
(*b*.) Mechanics of Fluids.
ii. Chemistry.
iii. Animal Physiology.
iv. (*a*.) Sound.
(*b*.) Light.
(*c*.) Heat.
v. (*a*.) Magnetism.
(*b*.) Electricity.
vi. Physiography.
vii. Botany.
viii. Principles of Agriculture.
ix. Hygiene.
x. Physics.

Then the Third and Fourth Years will be left free for the securing a First-Class Advanced.

At present there is an absurd regulation which allows no marks at the Scholarship Examination for any Science Certificate obtained more than two years previously.

VI.—Examination Practice.

Many examinees suffer from neglecting to answer a sufficient number of questions in a model style. The Education Department says that 'Managers and Teachers should obtain for Pupil-Teachers, during the last year of their engagement, special assistance in connection with any subjects in which the examinations of the previous years have shown them to be deficient.'

Now, although this applies primarily to Scholarship Candidates, it is also of great force during the preceding years of apprenticeship—coming events should cast their shadows before—and for the additional reason that H.M. Inspector is directed to examine the Note-Books, Answered Questions, &c., relating to the Pupil-Teacher's work during the year.

To meet these instructions, and to comply with the requests of many Readers, we have arranged to mark the questions set with these articles, and to afford full solutions, &c., for half-a-guinea per annum, paid in advance.

Address—

Dr. G. Beach, M.A.,
(Examination Editor of 'Practical Teacher')
Stanley Mount,
Macclesfield.

VII.—Variation in Routine of Geography and History for April 1895 Examination.

A. *Geography.*
All Geography of England, with Physical and Political Maps.

B. *History* from 1066 to 827, with dates.

VIII.—Model Answers to Mathematics of April 1894 Examination.

Third Year.—Girls.

1. (*a*) What is your method of dividing one decimal by another? Take, as an example, 8·046 divided by 14·9.

(*b*) Simplify $\frac{\cdot285 \times \cdot002 \times 1\cdot8}{\cdot009 \times \cdot038}$.

(*a*) In Division of decimals, equalise the number of decimal places, and proceed as in ordinary division. The quotient will be whole numbers. If it be necessary during the process to add to the decimal places of the dividend, the number of decimal places in the quotient will be equal to the excess of those in the dividend above those in the division.

$$\frac{8\cdot046}{14\cdot9} = \frac{8\cdot046}{14\cdot900} = \frac{8\cdot04600}{14\cdot900} = \underline{5\cdot4}. \text{ Ans.}$$

(*b*) $$\frac{\cdot285 \times \cdot002 \times 1\cdot8}{\cdot009 \times \cdot038} = \frac{285 \times 2 \times 1\cdot8}{9 \times 38 \times 10} = \underline{3}. \text{ Ans.}$$

2. Reduce £·64375 + ·025 of £1 5s. to the decimal of ·675 of £2.

$$\frac{\text{£}\cdot64375 + \cdot025 \text{ of £1 5s.}}{\cdot675 \times \text{£2}} = \frac{2\cdot575 \text{ cr.} + \cdot125 \text{ cr.}}{5\cdot4 \text{ cr.}}$$

$$= \frac{2\cdot7}{5\cdot4} = \cdot5. \text{ Ans.}$$

3. After paying 7d. in the £ income tax, a person has £625 18s. 10¾d. What was his gross income?

When a man pays 7d. in the £ he has $\frac{233}{240}$ of gross income left.

Now $\frac{233}{240}$ of Gross Income = £625 18s. 10¾d ;
∴ $\frac{1}{240}$,, ,, = £ 2 13s. 8¾d. ;
∴ ,, ,, = £ 2 13s. 8¾d. × 240 ;
= £644 15s. Ans.

4. Find the value of ·8⅓ of 13s. 4d. + ·13$\dot{8}$ of £1 4s., and express the result as the decimal of £13.

$$\frac{\cdot8\frac{1}{3} \text{ of 13s. 4d.} + \cdot13\dot{8} \text{ of £1 4s.}}{\text{£13}} = \frac{\text{£}\frac{5}{6} \times \frac{8}{9} + \text{£}\frac{5}{36} \times \frac{8}{9}}{\text{£13}}$$

$$= \frac{\frac{5}{9} + \frac{1}{9}}{13} = \frac{1\frac{1}{3}}{13} = \frac{1}{12} = \underline{\cdot05} \text{ Ans.}$$

5. Equal quantities of tea which cost 2s. and 1s. 8d. per lb. respectively, are mixed and sold for 2s. 2d. per lb., at a total profit of £3. How many pounds were sold?

Cost of 1 lb. of tea = $\frac{2\text{s.} + 1\text{s. } 8\text{d.}}{2}$ = 1s. 10d.

∴ profit on 1 lb. = 2s. 2d. minus 1s. 10d. = 4d. ;

∴ no. of lbs. = $\frac{\text{£}3}{4\text{d.}} = \frac{720}{4} = \underline{180 \text{ lbs.}}$ Ans.

6. Large needles cost 1d. per score more than small needles. A girl who buys equal quantities of both finds that on the whole she gets 8 for a penny. What is the price per score of each kind?

Cost of 4 of larger + cost of 4 smaller = 1d. ;
∴ ,, 20 ,, + ,, 20 ,, = 5d.

But as 20 of larger cost 1d. more than 20 of smaller,
∴ Cost of 40 smaller = 4d.
∴ { Smaller are 2d. / Larger are 3d. } per score. Ans.

THIRD YEAR.—BOYS.

1. Establish a general method or rule for reducing a circulating decimal to a vulgar fraction.

Simplify $\left(\frac{4\cdot\dot{6}}{7\frac{8}{9}} \times \frac{19\frac{7}{12}}{9\cdot\dot{3}}\right) - \left(\frac{3\cdot\dot{5}}{4\cdot1\dot{6}} \div \frac{2\frac{11}{12}}{3\frac{1}{3}}\right)$.

(*a*) Take for example $\cdot\dot{1}42857\dot{1}$.

Then $1000000 \times \cdot\dot{1}42857\dot{1} = 142857\cdot\dot{1}42857\dot{1}$.
" $1 \times \cdot\dot{1}42857\dot{1} = \cdot\dot{1}42857\dot{1}$;
∴ $999999 \times \cdot\dot{1}42857\dot{1} = \cdot142857$;
∴ $\cdot\dot{1}42857\dot{1} = \frac{142857}{999999} = \frac{1}{7}$.

Similarly, any other pure circulator can be transformed. The rule, therefore, evidently is, 'Place as denominator as many nines as there are repeating figures in the numerator.'

(*b*) $\left(\frac{3\cdot4}{4\frac{7}{8}} \times \frac{33\frac{3}{4}}{3\frac{5}{8}}\right) - \left(\frac{3\frac{2}{5}}{2\frac{5}{8}} \div \frac{2\frac{5}{8}}{\frac{7}{8}}\right)$

$= \left(\frac{28}{47} \times \frac{235}{112}\right) - \left(\frac{64}{75} \div \frac{35}{42}\right)$

$= \frac{5}{4} - \left(\frac{64}{75} \times \frac{6}{5}\right) = \frac{5}{4} - \frac{128}{125} = \frac{625-512}{500} = \frac{113}{500}$; or

·226 Ans.

2. At what rate per cent., simple interest, will £335 amount to £435 10s. in 4 years?

Interest = £435 10s. minus £335 = £100 10s.
Problem is now a Compound Proportion sum.

As £335 : 100 :: £100 10s. : x
4 : 1

$\frac{201 \times 100}{2 \times 4 \times 335} = \frac{15}{2} = 7\frac{1}{2}$ per cent. Ans.

3. An observer, on the platform of a railway station, noticed that a train passed him in 7 seconds; and that it passed completely through the station, which was 396 yards long, in 25 seconds. How long was the train, and how fast was it moving?

$\frac{396 \text{ yds.} + \text{Length of train}}{25}$ = rate per sec. in yards.

Also $\frac{\text{Length of train}}{7}$ = " " "

∴ $\frac{396 \text{ yds.} + \text{Length of train}}{25} = \frac{\text{Length of train}}{7}$;

∴ 2,772 yds. + 7 times length of train = 25 times length of train;
∴ 2,772 yards = 18 times length of train.
∴ 154 yds. = length of train. Ans.

∴ $\frac{154}{7}$ yds. = 22 yds. per second = rate of train. Ans.

4. Find, to a fraction of a penny, the true discount on £500; one moiety being due in 6 months, and the other in 9 months; discount being reckoned at 5 per cent. per annum.

£100 in 6 months at 5 per cent. amounts to £102 10s.
∴ Discount on £102 10s. = £2 10s.
∴ " " £250 = £2 10s. × $\frac{250}{102\frac{1}{2}}$
= £2 10s. × $\frac{100}{41}$
= £6 1s. $11\frac{1}{41}$d.

Again, £100 in 9 months at 5 per cent. amounts to £103 15s.
∴ Discount on £103 15s. = £3 15s.
∴ " " £250 = £3 15s. × $\frac{250}{103\frac{3}{4}}$
= £3 15s. × $\frac{200}{83}$
= £9 0s. $8\frac{52}{83}$;
∴ Total discount = £6 1s. $11\frac{1}{41}$d. + £9 0s. $8\frac{52}{83}$d.
= £15 2s. $8\frac{2084}{3403}$d.;
∴ £15 2s. 8d. Ans.

5. A man insured his life for £3,500 at a yearly premium of £65; he died immediately after making his fourth annual payment. How much did the company lose by the transaction, if money was then worth 5 per cent., compound interest?

£65	0	0	= First payment.
3	5	0	= " Interest at 5 per cent.
£68	5	0	
65	0	0	
£133	5	0	= Principal for 2nd year.
6	13	3	= Interest " "
£139	18	3	
65	0	0	
£204	18	3	= Principal for 3rd year.
10	4	$10\frac{18}{20}$	= Interest " "
£215	3	$1\frac{18}{20}$	
65	0	0	
£280	3	$1\frac{18}{20}$	= Principal for 4th year.

∴ Loss = £3,500 minus £280 3s. $1\frac{18}{20}$d.
= £3,219 16s. $10\frac{2}{20}$d. Ans.

6. A began business with £450 capital, and at the end of four months he took B into partnership with £300. Two months later they took in C with £500 capital; but, three months afterwards, C withdrew £250 from the concern. At the end of twelve months there was a profit of £502 10s. to be divided among them. Find each partner's share of that profit?

A's capital £450 for 12 months = £5,400 for 1 month.
B's " £300 for 8 " = £2,400 " .
C's " £250 for 6 " } = £2,250 "
C's " £250 for 3 " }
Total capital = £10,050 "

∴ A's share of profit £502 10s. = $\frac{5,400}{10,050} \times$ £502 10s.
= 5,400s.
= £270. Ans.

∴ B's share = 2,400s. = £120. Ans.

∴ C's " = 2,250s.
= £112 10s. Ans.

SECOND YEAR.—GIRLS.

1. What is meant by a decimal fraction? Explain the method of reducing a vulgar fraction to a decimal, taking as examples, $\frac{68}{425}$ $\frac{16}{25}$.

(*a*) A decimal fraction is a vulgar fraction with an understood denominator consisting of 10 to that power whose index is represented by the number of places in the numerator;

thus, $\cdot3 = \frac{3}{10} = \frac{3}{10^1}$ and $\cdot065 = \frac{65}{1000} = \frac{65}{10^3}$.

(*b*) Reducing a vulgar fraction to a decimal is really a problem in division of decimals.

$\frac{68}{425} = 68\cdot0 \div 425\cdot = 272 \div 1700 = 16 \div 100 = \cdot\dot{1}6\dot{}$ Ans.

(*c*) $\frac{10}{13} = \frac{10000000}{13000000} = \frac{\cdot769230}{1000000} = \cdot\dot{7}69230\dot{}$ Ans.

2. From $11\frac{3}{8}$ $\left(\frac{2\frac{1}{2}}{7} + \frac{4}{5}\text{ of }\frac{3\frac{3}{8}}{4\frac{1}{2}}\right)$ take $11\frac{3}{8}$ of $\frac{2\frac{1}{2}}{7} + \frac{4}{5}$ of $\frac{3\frac{3}{8}}{4\frac{1}{2}}$.

$\frac{91}{8}\left(\frac{5}{14} + \frac{4}{5} \times \frac{9}{10}\right) - \left(\frac{91}{8} \times \frac{5}{14} + \frac{4}{5} \times \frac{9}{10}\right)$
$= \frac{91}{8}\left(\frac{5}{14} + \frac{2}{5}\right) - \left(\frac{91}{8} + \frac{2}{5}\right)$
$= \frac{91}{8} \times \frac{53}{70} - \frac{251}{80}$
$= \frac{689}{80} - \frac{251}{80} = \frac{438}{80} = 4\frac{3}{10}$ or $4\cdot15$. Ans.

3. Reduce the sum of $\frac{3}{7}$ of 4s. $4\frac{1}{2}$d. + $\frac{5}{13}$ of 8s. $11\frac{1}{2}$d. to the fraction of $\frac{17}{26}$ of 7s. 11d.

$\frac{\frac{3}{7} \times 4\text{s. } 4\frac{1}{2}\text{d.} + \frac{5}{13} \times 8\text{s. } 11\frac{1}{2}\text{d.}}{\frac{17}{26} \times 7\text{s. } 11\text{d.}} = \frac{1\text{s. } 10\frac{1}{2}\text{d.} + 3\text{s. } 5\frac{1}{2}\text{d.}}{7\text{s. } 1\text{d.}}$
$= \frac{5\text{s. } 3\frac{1}{2}\text{d.}}{7\text{s. } 1\text{d.}} = \frac{253}{340} = \frac{23}{68} = \frac{1}{2}$. Ans.

4. Express the sum of $\frac{7}{66}$ of $\frac{3}{22}$ of a mile + $\frac{3}{880}$ of $1\frac{1}{8}$ of $\frac{1}{22}$ of a furlong as a fraction of 13 yards.

$\frac{\frac{5}{8} \times \frac{3}{44} \times \frac{1760}{1} + \frac{3}{880} \times \frac{9}{8} \times \frac{7}{22} \times \frac{220}{1}}{13} = \frac{\frac{50}{9} + \frac{15}{8}}{13}$
$= \frac{65}{9} \div 13 = \frac{5}{9}$ or $\cdot\dot{5}$. Ans.

5. Find, by Practice, without using the same aliquot part twice, the value of 119 cwt. 3 qrs. 25 lbs., at £9 6s. 8d. per ton.

119 cwts. 3 qrs. 25 lbs. = 6 tons minus 3 lbs.

(*a*) £9 6s. 8d. = cost per ton.

6

£56 0s. 0d. = ,, of 6 tons.

(*b*) 2 lbs. of 1 ton = $\frac{1}{1120}$ | £9 6s. 8d. = cost per ton.
1 lb. of 2 lbs. = $\frac{1}{2}$ | 2d. = ,, ,, 2 lbs.
1d. = ,, ,, 1 ,,
3d. = ,, ,, 3 ,,

(*c*) ∴ Cost of 119 cwts. 3 qrs. 25 lbs. = £56 minus 3d.
= £55 19s. 9d. Ans.

6. A train consists of engine, tender, and eight carriages. The weight of the engine and tender equals $\frac{8}{25}$ of the total weight of the train, and is 72 tons less than the weight of the carriages. Find the weight of a carriage.

Weight of carriages = $\frac{17}{25}$ of total weight ;
∴ $\frac{8}{25}$ + 72 tons = $\frac{17}{25}$;
∴ 72 ,, = $\frac{9}{25}$;
∴ 8 ,, = $\frac{1}{25}$;
∴ 200 ,, = weight of whole train ;
∴ 1 carriage = $\frac{17}{25} \times \frac{200}{1} \times \frac{1}{8}$ = 17 tons. Ans.

SECOND YEAR.—BOYS.

1. Explain fully, as to a class, the meaning of the terms *principal, rate per cent.*, and *amount*, as applied to simple interest.

What sum must be lent at simple interest, at 2½ per cent. per half-year, to amount in 4 years to £2,360?

(*a*) (α) *Principal* equals money lent out at interest.
(β) *Rate per cent.* means so many hundredths of Principal.
(γ) *Amount* is the sum of the Principal and Interest.

(*b*) 2½ per cent. per half-year, Simple Interest = 5 per cent per year.
£100 @ 5 per cent for 4 years amounts to £120.
∴ As £120 : £2360 :: £100 : *x*.

$$\frac{£100 \times 2360}{120} = £1966\ 13s.\ 4d.$$ Ans.

2. A house costs £750, and the ground rent is £20 a year. At how much a year must it be let to pay 5 per cent., after allowing 4 per cent. annually for repairs?

This sum is carelessly worded. What is the 4 per cent. on—the rental or the cost of house?

(*a*) *First, on rental,*
5 per cent on £750 = £37 10s. 0d.
∴ house rent (less ground rent) = $\frac{100}{95} \times$ £37 10s. 0d.
= 25 × £1 11s. 3d = £39 1s. 3d.
∴ gross rental = £59 1s. 3d. Ans.

(*b*) *Second, on cost of house,*
9 per cent on £750 = £67 10s. 0d.
9 per cent. on £750 + ground rental = £87 10s. 0d. Ans.
[We believe the first answer to be intended.]

3. The £5 shares in a certain company, which were bought at par, have paid during the last six years a total of 45 per cent. Supposing the average dividend to remain the same, what will be the gain per cent. when the shares are at 15 per cent. premium?

Average annual percentage = 7½.

When shares are at 15 per cent. premium, the real percentage is $\frac{100}{115}$ of $\frac{15}{2} = \frac{150}{23} = 6\frac{12}{23}$. Ans.

4. 600 men were besiged in a garrison town with provisions for 35 days, allowing each man 18 oz. a day. How long would the provisions last it the garrison were reinforced by 300 men, and the daily allowance were reduced to 15 oz. a day?

As 900 men : 600 men :: 35 days : *x*
15 ozs. : 18 ozs. ::

$$\frac{35 \times 600 \times 18}{900 \times 15}\ \text{days} = 28\ \text{days}.$$ Ans.

5. How much must a person invest in the 2¾ per cent. stock, at 98$\frac{7}{8}$, in order that he may have a yearly income of £233, after paying an income tax of 7d. in the pound?

(*a*) Net yearly income = £233.
∴ Gross ,, ,, = $\frac{240}{233} \times$ £233 = £240.
As £2 15s. : £240 :: £98 17s. 6d. : *x*.

£98 17s. 6d. × $\frac{240}{237}$ = £2157 5s. $5\frac{5}{11}$d. × 4
= £8629 1s. $9\frac{9}{11}$d. Ans.

(*b*) *With brokerage of* $\frac{1}{8}$ *per cent.*
As £2 15s. : £240 : : £99 0s. 0d.

$$\frac{£99 \times 240}{\frac{11}{4}} = £36 \times 240 = £8640.$$ Ans.

6. A grocer mixes 16 lbs. of tea, at 2s. 8d. per lb., with 28 lbs. at 2s. 6d. per lb., and 11 lbs. at 2s. 4d. per lb. What does he gain per cent. if he sells the mixture at 2s. 9d. per. lb.?

16 lbs. @ 2s. 8d. per lb. = 42s. 8d.
28 ,, 2s. 6d. ,, = 70s. 0d.
11 ,, 2s. 4d. ,, = 25s. 8d.
Cost of 55 lbs. = 138s. 4d.
Selling price of 55 lbs. @ 2s. 9d. = 151s. 3d.
∴ Profit = 12s. 11d.
As 151s. 3d. : £100 :: 12s. 11d. : *x* ;
or 1815 : 155 :: £100

$$\frac{£100 \times 155}{1815} = £\frac{8100}{363} = 8\frac{126}{363}$$ per cent. Ans.

FIRST YEAR.—BOYS.

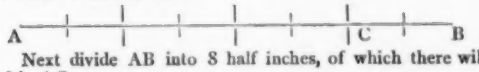
1. How are fractions compared? Show by a diagram that if the numerator and denominator of the fraction $\frac{3}{4}$ be each multiplied by 2 its value is not altered.

Compare $\frac{3}{4}$, $\frac{1}{2}$, $\frac{2}{7}$, $\frac{5}{14}$; and find the difference between the sum of the greatest and least, and the sum of the other two.

(*a*) Fractions may be compared in two ways, either by reduction to a common denominator or a common numerator.

Thus compare $\frac{3}{4}$ and $\frac{4}{5}$; $\frac{3}{4} = \frac{15}{20}$ and $\frac{4}{5} = \frac{16}{20}$;
Also $\frac{3}{4} = \frac{12}{16}$ and $\frac{4}{5} = \frac{12}{15}$.

(*b*) Draw a line AB 4 inches long ; then AC, 3 inches long, is three-fourths of AB.



Next divide AB into 8 half inches, of which there will be 6 in AC ;
∴ 3 inches out of 4 = 6 half-inches out of 8.

(*c*) $\frac{3}{4}$, $\frac{1}{2}$, $\frac{2}{7}$, $\frac{5}{14} = \frac{42, 7, 16, 20}{56}$;

$$\frac{(42 + 7) - (16 + 20)}{56} = \frac{13}{56}.$$ Ans.

2. If the smaller of two fractions be $\frac{3}{5}$, and their difference $\frac{5}{14}$, what is their sum?

Find the quotient of the sum divided by twice the difference.

(*a*) Larger fraction = $\frac{3}{5} + \frac{5}{14} = \frac{7}{8}$;
∴ Sum of fractions = $\frac{3}{5} + \frac{7}{8} = \frac{37}{40} = 1\frac{17}{40}$. Ans.

(*b*) $\frac{37}{40} \div \frac{5}{12} = \frac{37}{40} \times \frac{12}{5} = \frac{37}{10} = 3\frac{7}{10}$. Ans.

3. Simplify $\left(3\frac{1}{5} + \frac{2\frac{1}{2}}{6} - \frac{1\frac{1}{2}}{9}\right) - \frac{2}{5}$ of $\frac{1\frac{1}{15} - \frac{2}{5}}{\frac{1}{3}}$.

$$(1\tfrac{9}{15} + \tfrac{15}{42} - 1\tfrac{3}{18}) - \tfrac{2}{5} \times \frac{\frac{2}{3}}{\frac{1}{3}}$$

$$= \tfrac{3}{5} + \tfrac{5}{14} - \tfrac{1}{6} - \tfrac{4}{5} = \frac{28 + 15}{42} - \frac{5 + 24}{30}$$

$$= \tfrac{43}{42} - \tfrac{29}{30} = \frac{215 - 203}{210} = \tfrac{12}{210} = \tfrac{2}{35}.$$ Ans.

4. Find the value of 1·38 of £27 ; and express 6·875 lbs. as the decimal of 2½ cwts. (to 5 places of decimals).

(*a*) 1·38 × £27 = £$\frac{138}{100} \times \frac{27}{1}$ = £$\frac{37}{2}$ = £37 10s. 0d. Ans.

(*b*) $\frac{6 \cdot 875 \text{ lbs.}}{2\frac{1}{2} \text{ cwts.}} = \frac{6875}{280000} = \frac{11}{448} = \cdot 02455 +$. Ans.

5. If I gave away $\frac{5}{8}$ of my money and ·375 of the remainder, and have £1·6875 left ; what sum had I at first?

$\frac{5}{8}$ of money + ·375 of $\frac{3}{8}$ of money + £1·6875 = sum of money,
$(\frac{5}{8} + \frac{3}{8})$ of money + £1·6875 = sum of money,
$\frac{14}{16}$ of money + £1·6875 = sum of money;
∴ £1·6875 = $\frac{14}{16}$ of money ;
∴ £·3375 = $\frac{1}{16}$ of money ;
∴ £6·075 = money ;
∴ £6 1s. 6d. = Ans.

6. Multiply £135 14s. $9\frac{3}{11}$d. by 96; and show whether $\frac{22}{7}$ or $\frac{355}{113}$ is nearer to 3·14159.

(*a*) £135 14s. $9\frac{3}{11}$ × 96 = £1,085 18s. $2\frac{8}{11}$d. × 12
= £13,030 18s. $2\frac{3}{11}$d. Ans.

(*b*) $\frac{22}{7}$ = 3·142857
$\frac{355}{113}$ = 3·141509.
Difference between 3·142857 and 3·14159 = ·00126$\frac{7}{14285}$.
Difference between 3·141509 and 3·14159 = ·000081. Ans.

FIRST YEAR.—GIRLS.

1. What is meant by a 'factor' or 'measure' of two or more numbers? Find the G.C.M. and L.C.M. of
13 × 15 × 17, 15 × 17 × 19, 17 × 19 × 13.

(*a*) A *Factor* or *Measure* of two or more numbers is a number which will divide the two or more numbers exactly.

(*b*) G.C.M. of 13 × 15 × 17; 15 × 17 × 19; 17 × 19 × 13.
From inspection 17 is the G.C.M. Ans.

(*c*) L.C.M. of 13 × 15 × 17; 15 × 17 × 19; 17 × 19 × 13
= 13 × 15 × 17 × 19 = 62985. Ans.

2. Make out a bill for 7 packets of tea, each containing 5 oz., at $1\frac{1}{2}$d. per oz.; $8\frac{3}{4}$ lbs. of coffee, at 1s. 4d. per lb.; 32 packets of sugar, each containing 3 oz., at $2\frac{3}{4}$d. per lb.; and $12\frac{1}{2}$ lbs. of fruit, at $5\frac{1}{4}$d. per lb.

Mill Street, Macclesfield,
14th April, 1894.

J. W. Jones, Esq.
To Earlam and Co., Grocers.

	£	s.	d.
7 packets of tea, each 5 oz., @ $1\frac{1}{2}$d. per oz. ...	0	4	$4\frac{1}{2}$
$8\frac{3}{4}$ lbs. of coffee @ 1s. 4d. per lb.	0	11	8
32 packets of sugar, each 3 oz., @ $2\frac{3}{4}$d. per lb...	0	1	$4\frac{1}{2}$
$12\frac{1}{2}$ lbs. of fruit @ $5\frac{1}{4}$d. per lb.	0	5	$8\frac{3}{4}$
	£1	3	$1\frac{3}{4}$

3. Find the cost of 825 articles at £2 17s. $8\frac{1}{2}$d. each.

£	s.	d.
825	0	0 = cost @ £1
		2

	£1,650	0	0	= cost @ £2
10s. of £1 = $\frac{1}{2}$	412	10	0	= cost @ £0 10 0
5s. of 10s. = $\frac{1}{2}$	206	5	0	= cost @ £0 5 0
2s. 6d. of 5s. = $\frac{1}{2}$	103	2	6	= cost @ £0 2 6
$2\frac{1}{2}$ of 2s. 6d. = $\frac{1}{40}$	8	11	$10\frac{1}{2}$	= cost @ £0 0 $2\frac{1}{2}$
Ans.	£2,380	9	$4\frac{1}{2}$	= cost @ £2 17 $8\frac{1}{2}$

4. What is the cost of 112 cwt. 3 qrs. 17 lbs. 8 oz. at £9 6s. 8d. per ton? N.B. 112 cwt. = 5 tons 12 cwt.

£	s.	d.
9	6	8 = cost of 1 ton.
		5

	£46	13	4	= cost of 5 tons.
10 cwt. of 1 ton = $\frac{1}{2}$	4	13	4	= cost of 0 10 cwt.
$2\frac{1}{2}$ cwt. of 10 cwt. = $\frac{1}{4}$	1	3	4	= cost of 0 2 2 qrs.
1 qr. of $2\frac{1}{2}$ cwt. = $\frac{1}{10}$	0	2	4	= cost of 0 0 1 qr.
16 lbs. of 1 ton = $\frac{1}{140}$	0	1	4	= cost of 0 0 0 16 lbs.
1 lb. of 16 lbs. = $\frac{1}{16}$	0	0	1	= cost of 0 0 0 1 lb.
8 ozs. of 1 lb. = $\frac{1}{2}$	0	0	$0\frac{1}{2}$	= cost of 0 0 0 8 ozs.
Ans.	£52	13	$9\frac{1}{2}$	= cost of 5 12 3 17 8.

5. A merchant gave £27 6s. for 7 bales of cloth, each containing 24 yards. In each bale 2 yards were wasted, at what price yer yard must he sell the remainder in order to make a profit of £3 10s.?

Cost of cloth = £27 6 0
Profit = £ 3 10 0
∴ Selling price = £30 16 0
Selling price of 154 yds. = £30 16 0
∴ Selling price of 1 yd. = 4s. 0d. Ans.

6. Two pedlars buy equal stocks of toys which they sell at a penny each. One gave 5d. for 6 toys, the other got 7 toys for 6d. and made 3d. less profit than the other when the stocks were sold. How many toys were bought by each?

A gave $\frac{5}{6}$d. per toy; ∴ A gained $\frac{1}{6}$d. per toy.
B gave $\frac{6}{7}$d. per toy; ∴ B gained $\frac{1}{7}$d. per toy.
∴ A gained on each toy $\frac{1}{42}$d. more than B;
∴ A gained on 126 toys 3d. more than B.
Ans. 126.

ALGEBRA.

THIRD YEAR.—BOYS.

1. (*a*) Explain the method of dividing one multinominal expression by another.

(*b*) Divide $x^4 + x^2y^2 + y^4$ by $y^2 + x^2 - xy$.

(*a*) (α) Arrange both Divisor and Dividend in the same manner as regards orderly descent or ascent of indices and combinations of factors (letters).

(β) Use the first term of the Divisor as a trial divisor of the first term of Dividend.

(γ) Take care to multiply *all* the Divisor by the new term in the Quotient.

(δ) After subtraction and due 'bringing down' of terms repeat processes (β) and (γ).

(ε) Continue the process until the Dividend contains no term similar to the first one (the trial Divisor) of the Divisor.

(*b*) $\frac{x^4 + x^2y^2 + y^4}{x^2 - xy + y^2} = x^2 + xy + y^2$ Ans.

2. Find the Highest Common Factor of:—

(*a*) $4a^4 - 5a^2 + 1$ and $4a^3 + 12a^2 - a - 3$;

(*b*) $x^2 - 4a^2 + 12a - 9$ and $x^2 + 2x - 4a^2 + 8a - 3$.

(*a*) $4a^4 - 5a^2 + 1 = (2a + 1)(2a - 1)(a + 1)(a - 1)$
$4a^3 + 12a^2 - a - 3 = (2a + 1)(2a - 1)(a + 3)$.
∴ $(2a + 1)(2a - 1)$ or $4a^2 - 1$ = Ans.

(*b*) $x^2 - 4a^2 + 12a - 9 = (x + 2a - 3)(x - 2a + 3)$.
$x^2 + 2x - 4a^2 + 8a - 3 = (x + 2a - 1)(x - 2a + 3)$.
∴ $x - 2a + 3$ = Ans.

3. (*a*) Simplify $\frac{a^3 + b^3}{ab(b^2 - a^2)} - \frac{b}{a^2 + ab} + \frac{a}{ab - b^2}$;

(*b*) And if $\frac{a}{b} = \frac{c}{d}$, prove that $a^2(c + d)^2 = c^2(a + b)^2$.

(*a*) $\frac{(a + b)(a^2 - ab + b^2)}{-ab(a + b)(a - b)} - \frac{b}{a(a + b)} + \frac{a}{b(a - b)}$

$= \frac{a^2 - ab + b^2}{-ab(a - b)} - \frac{b}{a(a + b)} + \frac{a}{b(a - b)}$

$= \frac{a^4b + ab^4 + a^2b^3 - ab^4 - a^4b - a^3b^2}{-ab \times ab(a - b)(a + b)}$

$= \frac{a^2b^2(b - a)}{a^2b^2(b - a)(a + b)} = \frac{1}{a + b}$. Ans.

(*b*) $\frac{a}{b} = \frac{c}{d}$; ∴ $\frac{a}{c} = \frac{b}{d}$; $\frac{a}{c} = \frac{a + b}{c + d}$; $\frac{a^2}{c^2} = \frac{(a + b)^2}{(c + d)^2}$;
∴ $a^2(c + d)^2 = c^2(a + b)^2$.—Q.E.D.

4. (*a*) Solve the equation
$\frac{2x - 1}{6} - \frac{x - 36}{15} = \frac{2x - 1}{3} + \frac{19 - 2x}{42}$.

(*b*) A and B have £100 between them. After A had spent half his money, and B had spent one-third of his, they had £55 between them. How much had each at first?

(*a*) $\frac{10x - 5}{30} - \frac{2x - 72}{30} = \frac{28x - 14}{42} + \frac{19 - 2x}{42}$.

$\frac{8x + 67}{30} = \frac{26x + 5}{42}$.

$56x + 469 = 130x + 25$.

$444 = 74x$.

$x = 6$. Ans.

Let x in £ = A's share;
then 100 − x = B's share;

$\frac{x}{2} + \frac{2}{3}(100 - x) = 55$;

$3x + 400 - 4x = 330$;

$x = 70$.

A had £70, B had £30. Ans.

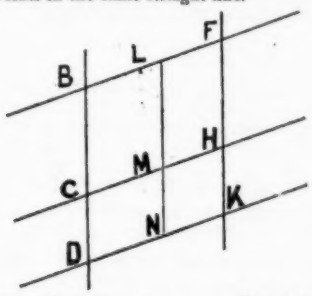
EUCLID.

THIRD YEAR.—BOYS.

1. If a straight line fall on two parallel straight lines, it makes the alternate angles equal to one another, and the exterior angle equal to the interior and opposite angle on the same side.
Proposition 29, Book 1.

2. To describe a parallelogram equal to a given rectilineal figure, having an angle equal to a given rectilineal angle.
Proposition 45, Book 1.

3. Two parallel straight lines cut a series of parallel straight lines. Show that the parts of the latter intercepted by the former have their middle points in the same straight line.



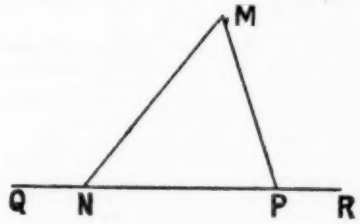
Let BCD and FHK be the two parallel straight lines.
,, FLB, HMC, and KND be a series of three parallel straight lines.
Let LN be the middle points respectively of BF and DK.
Then LN shall bisect CH in M.

Proof—
∴ BK is a parallelogram BF = DK = CH (I. 34).
∴ BL = DN (Hypothesis, etc.).
∴ NL is parallel to DB (I. 33).
∴ BN and BM are parallelograms. ∴ DN = CM (I. 34).
But since CH = DK and DN is half of DK, ∴ CM is half of CH.
∴ L, M, N are in a straight line.
Similarly, all the middle points of any number of similar parallel straight lines will be all in the same straight line. —Q.E.D.

SECOND YEAR.—BOYS.

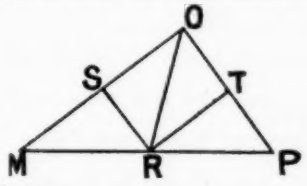
1. Define *a point, a figure, an acute-angled triangle.*
From a given point, to draw a straight line equal to a given straight line.
(*a*) See any Euclid.
(*b*) Euclid I. 2.

2. (*a*) If one side of a triangle be produced, the exterior angle shall be greater than either of the interior opposite angles.
(*b*) Any two exterior angles of a triangle are together greater than two right angles.
(*a*) Euclid I. 16.
(*b*) ∧ MNQ + ∧ MPR are greater than two right angles.



Proof—
∧s MNQ + MNP + MPN + MPR = four right angles (I. 13).
But ∧s MNP + MPN are less than two right angles (I. 17).
∴ ∧s MNQ + MPR are greater than two right angles. —Q.E.D.

3. Find a point equally distant from three given points.
Let M, O, P be any three points (not in a straight line).
It is required to find a point R equidistant from M, O and P.



Construction—
Bisect MO in S, and PO in T (I. 10).
Draw SR at right angles to MO, and TR at right angles to PO (I. 11), and let them meet in R. Then R is required point.

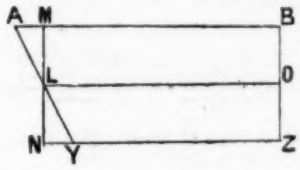
Proof—
∴ RS, SO, ∧ RSO = RS, SM, ∧ RSM respectively,
∴ RO = RM (I. 4).
Similarly RO = RP,
∴ RO = RM = RP.—Q.E.D.
N.B.—M, R, P will only be in a straight line when M is a right angle.

MENSURATION.

THIRD YEAR.—BOYS.

(*Answer one Question.*)

1. (*a*) Prove the rule for finding the area of a quadrilateral of which two opposite sides are parallel; and (*b*) find the area when the parallel sides are 12·5 chains and 15·75 chains, and the distance between them is 9·25 chains.
(*a*) Let ABYZ be the given quadrilateral, having sides AB and YZ parallel, but sides AY and BZ not parallel.
Bisect AY in L and draw MLN parallel to BZ.



Then ∵ LM, ∧ LMA, ∧ MAL = LN, ∧ LNV, ∧ NYL respectively,
∴ triangle LMA = triangle LNY, and LO = $\frac{AB + YZ}{2}$ = NZ.
∴ parallelogram MZ = quadrilateral AZ.
But parallelogram MZ = rect. contained by NZ and perp. between NZ and MB.
∴ quadrilateral AZ = rect. contained by $\frac{AB + YZ}{2}$ × perp. between NZ and MB.—Q.E.D.

(*b*) Area = $\frac{12\cdot5 + 15\cdot75}{2}$ × 9·25 sq. chains.
= $\frac{28\cdot25}{2}$ × 9·25 sq. chains = 130·65625 sq. chains. Ans.

2. Find the number of acres in a triangle whose sides are 64 poles, 100 poles, and 156 poles.
Area = $\sqrt{s\,(s-a)\,(s-b)\,(s-c)}$ where a, b, c are the sides of the triangle, and $s = \frac{a+b+c}{2}$,
Area = $\sqrt{160\,(96 \times 60 \times 4)}$ sq. poles.
= $\sqrt{1600 \times 64 \times 36}$ sq. poles.
= 40 × 8 × 6 sq. poles = 1920 sq. poles = 12 acres. Ans.

GOVERNMENT TEST QUESTIONS.

FIRST YEAR.

1. (*a*) Write down all the prime numbers between 1 and 50.
Ans. 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47.

(*b*) What are the prime factors of 2,997? Ans. $3^4 \times 37$.

(*c*) Give instances of a compound fraction, a complex fraction, and an improper fraction not in its lowest terms.

2. (*Boys.*) Express $1\frac{1}{5} \times 2\frac{3}{8} \times$ 1s. 2d. as a fraction of $2\frac{2}{3} \times 3\frac{1}{6} \times$ 3s. 4d. Ans. $\frac{57}{2560}$.

(*Girls.*) Make out the bill of 126 yds. at 10½d. per yd.; 39 loads at 7s. 7d. per load; 59 yds. at 11s. 5d. per yd.; 192 hours at 7¾d. per hour. Ans. £60 3s. 7d.

3. (*Boys.*) A man paid away ·6 of his money, and afterwards ·75 of what was left. What decimal of the whole then remained?
Ans. ·1 of the whole.

(*Girls.*) Prove that $9\frac{3}{4} + 7\frac{5}{8} - 3\frac{11}{12} + \frac{17}{24} - 12\frac{3}{32} = 2\frac{7}{96}$.

4. Write in Largehand the words—
Katherine, Lymphatic, Myriads, Nurture, Oyster.
Write in Smallhand—
'Now's the day and now's the hour
See approach proud Edward's power.'

5. Analyse the following lines and parse the italicised words:—
'*Alas!* they had *been friends* in youth,
But *whispering* tongues *can poison* truth,
And constancy dwells in realms *above*,
And life *is thorny* and youth is vain.'

6. Show by the use of suffixes how—
   (*a*) Nouns may be formed from verbs.
   (*b*) Verbs may be formed from adjectives.
   (*c*) Adjectives may be formed from nouns.

7. Give some account of the mountain system of England.

8. Describe the Yorkshire Ouse, introducing as many geographical river terms as you can.

9. Draw a map of Wales.

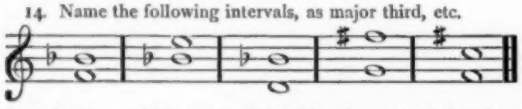
10. Name some of the great Roman Roads in England, their directions and the object with which they were made.

11. Explain these word terminations : *-cester, -by, -wick*, and what they tell us about the history of our country.

12. What do you understand by *hundred, tithing, frankpledge, sheriff* ?

13. How would you commence a series of lessons on Word-building to Standard I. ?

14. Name the following intervals, as major third, etc.



State between which tones of the following extended major scale there are (*a*) major thirds, (*b*) minor thirds :—

d r m f s l t d' r'

15. Decline *acutus gladius ; or,*
Darn a hole half an inch square on stocking material.

16. Mention with examples the principal methods of forming the feminine in French.

SECOND YEAR.

1. (*Boys.*) (*a*) Distinguish as to a class between *stock* and the *money value of stock*, giving examples.
(*b*) What is meant by buying at a *premium*, at *par*, at *discount* ?
(*c*) Explain *brokerage*. How much brokerage is customarily charged for the transfer of £500 stock from a 4 per cent. stock at 103¼ to a 3 per cent. stock at 98½ ? Ans. £1 5s. $7\frac{48}{97}$d.

(*Girls.*) (*a*) Obtain the decimal fractions equal to $\frac{1}{11}$, $\frac{7}{9}$, $\frac{11}{250}$, $\frac{7}{2000}$. Ans. $1\cdot\dot{3}\dot{6}$; $1\cdot\dot{2}8571\dot{4}$; ·044 ; ·0014.

(*b*) Explain the statement that $\cdot\dot{9} = 1$.

2. (*Boys.*) What is the rate per cent. received for money invested in the Four per Cents. at 83⅓ ? Ans. 4⅘ p.c.

(*Girls.*) Reduce $\{(\frac{8}{11} \times 6\frac{1}{9}) - (\frac{7}{17}$ of $3\frac{1}{11})\} \times 5\frac{1}{13}$ to a simple fraction in its lowest terms. Ans. $\frac{78}{286}$.

3. (*Boys.*) A tradesman selling off advertises a reduction of 10 per cent. from his marked prices. At what price must he mark articles for which he obtains a net price of 5s. 3d. ? Ans. 5s. 10d.

(*Girls.*) Make out the following accounts :—239 lbs. at 2s. 0½d. per lb. ; 598 lbs. at 10¾d. per lb. ; 700 lbs. at 2d. per lb. ; 480 lbs. at 1s. 1d. per lb. Ans. £83 0s. 4d.

4. As in First Year.

5. Analyse the following, and parse the italicised words :—
'The *notice which* you have *been pleased* to take of my labours, *had it been* early *had been* kind ; *but* it has been delayed *till I am indifferent*, and cannot enjoy it ; till I am solitary, and *cannot impart it ;* till I am *known*, and do not want it.'

6. Paraphrase—
'How beautiful is night !
A dewy freshness fills the silent air ;
No mist obscures, nor cloud, nor speck, nor stain
Breaks the serene of heaven :
In full-orbed glory yonder moon divine
Rolls through the dark-blue depths,
Beneath her steady ray
The desert circle spreads
Like the round ocean, girdled with the sky.'
Southey.

7. What are the chief industries of the south of France, north of Russia, and Sweden ?

8. How is latitude calculated ?

9. Draw a map of France.

10. What was the Black Death ? Give its date, and show its effects upon the cultivation of land.

11. What do you know about the 'Good Parliament' ? Show that its name was an appropriate one.

12. Give a short life of Wiclif, and show what part of his teaching had the effect of stirring up the common people.

13. What rules is it necessary to observe in giving out and in correcting a Dictation Lesson ?

14 Write the major scales of E♭ and A, placing the flats and sharps before the notes, and not in the signature ; *or,*
Re-write the following passage, making a change to the flat key at (*a*), and a return to the original key at (*b*) :—

(*a*) (*b*)
m f r d s ta m f l r f d' t d' r d

15. Write out the imperfect subjunctive of *audior* and *nolo ; or,*
Set in and herring-bone a flannel patch (two inches square).

16. Write out the subjunctive tenses of *finir* and *penser.*

17. (*a*) Define rectilineal angle, right angle.
(*b*) If two straight lines cut one another, the vertical or opposite angles are equal.

THIRD YEAR.

1. (*Boys.*) (*a*) Prove that if a vulgar fraction in its lowest terms be equivalent to a terminating decimal, the denominator of that fraction can only contain the prime numbers 2 and 5.

(*b*) Without reducing to vulgar fractions, solve—
(*α*) 2·15 × ·25. Ans. ·53̇8̇.
(*β*) 2·14̇ minus 1·7̇2̇5̇. Ans. ·41̇6̇.

(*Girls.*) (*a*) Give a rule for division of decimals which shall include all cases.
(*b*) Explain why the division of one decimal by another (each fraction being less than unity) may lead to an integral quotient.

2. (*Boys.*) A tradesman sold goods for 409·5 francs, at a gain of 17 per cent. What was their cost price in francs ?
Ans. 350 francs.

(*Girls.*) (*a*) When is a fraction said to be in its lowest terms ?
(*b*) Reduce to its lowest terms ·66619, and find the value of that fraction of £1 3s. 7¾d. Ans. £1 2s. 7½d. ; $\frac{3317}{4977}$.

3. (*Boys.*) What will be the cost of painting a room 32 ft. long, 18 ft. wide, and 11 ft. high, at 2s. 3d. per sq. yd., allowing for 3 windows each 6 ft. by 4 ft., and for 2 fireplaces each 5 ft. by 6 ft. ?
Ans. £12 2s.

(*Girls.*) If 1,661 tons of coal cost £1,518 3s. 7d., what will 572 tons cost ? Ans. £522 16s. 4d.

4. As in First Year.

5. Paraphrase.
Thou first and chief, sole Sovereign of the vale !
Oh, struggling with the darkness all the night,
And visited all night by troops of stars,
Or when they climb the sky, or when they sink.
Companion of the morning star at *dawn*,
Thyself Earth's rosy star, and of the dawn
Co-herald, wake, oh, wake, and utter praise !
Who sunk *thy sunless pillars* deep in earth ?
Who filled thy countenance with rosy light ?
Who made thee parent of *perpetual* streams ?
Explain separately the meaning of the italicised words.

6. Select from the foregoing passages any epithets which are not employed in a literal but in a figurative or poetical sense ; and say how you would explain their appropriateness to a class of older scholars.

7. Compare and contrast the physical features of Africa and Europe.

8. What is meant by *constant, periodical, counter,* and *drift currents* ?

9. Draw a map of India or Australia.

10. Give some account of literature during the reign of Elizabeth *or* Anne.

11. By what means other than Parliament did Henry VII. obtain money ? ; *or,*
What conditions were imposed upon William III. at his accession ?

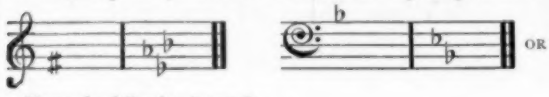
12. Give a short life of Wolsey or Marlborough.

13. Describe a good course of Geography Lessons from the Third to the Sixth Standards. Say how far you would rely upon oral teaching, and how far on book work in making such a course effective.

PUPIL TEACHERS' ROUTINE FOR MAY, 1894.

DAYS	YEARS	FIRST WEEK				SECOND WEEK				THIRD WEEK				FOURTH WEEK			
		First Lesson	Second Lesson	Third Lesson		First Lesson	Second Lesson	Third Lesson		First Lesson	Second Lesson	Third Lesson		First Lesson	Second Lesson	Third Lesson	
MONDAY	1	Analysis and Parsing (*See Article*)	Measures and Multiples. Practice	Literature, Repetition, and Writing		English from Text-book	How to teach Reading	History from 78 to 121 A.D.		Analysis and Parsing (*See Article*)	How to teach Writing	Geography of British North America		Paraphrasing (*See Article*)	How to teach Arithmetic	Physical Geography of Mountains	
	2		Theory of Proportion. Multip. of Vulgar Fractions					History from 1087 to 1106 A.D.				Geography of India				Longitude	
	3		Square Root. Addition and Subt. of Decimals				How to teach Geography	History from 1310 to 1535 A.D.			How to teach Grammar	Geography of Africa			How to teach Composition	Winds	
TUESDAY	1	⅓ of Euclid's Def. Book I. Garment with req. stitches	Geography of England	Scripture or Revision		⅓ of Euclid's Def. Garment with required stitches	Geography of England	Scripture or Revision		Post. & Ax. of Euc. Book I. Garment with req. stitches	French or Latin	Scripture or Revision		Euclid, Book I., Props. 1. Stocking-hole Mending	Add. of Algebra. Garment with required stitches	Scripture or Revision	
	2	⅓ of Euclid's Def. Book I. Garment with req. stitches	General Geography of Europe			All Euclid's Def. Garment with required stitches	Geography of France			Props. 1 & 2, Euc. Book I. Garment with req. stitches				Euclid, Book I., Props. 3, 4. Calico Patch	Subt. of Algebra. Garment with required stitches		
	3	Revise first 12 Props. Garment with req. stitches	General Geography of Asia			Revise first 26 Props. Garment with req. stitches	Geography of Turkey in Asia			Props. 29, 30, Euc. Book I. Garment with req. stitches				Euclid, Book I., Props. 31, 32. Hedge-tear Darn	Multip. of Algebra. Garment with required stitches		
WEDNESDAY	1	History from 55 B.C. to 78 A.D.	Introductory Algebra to end of Addition. Garment with the required stitches	Mensuration or Domestic Economy		Dates and main facts from 55 B.C. to 121 A.D.	Composition	Mental Arithmetic		History from 121 to 410 A.D.	English from Text-book	Mensuration or Domestic Economy		History from 410 to 787 A.D.	Prefixes, Roots, or Affixes	Mental Arithmetic	
	2	History from 1066 to 1087 A.D.				Dates and main facts from 1066 to 1106 A.D.				History from 1106 to 1153 A.D.				History from 1153 to 1189 A.D.			
	3	History from 1485 to 1510 A.D.				Dates and main facts from 1485 to 1535 A.D.				History from 1535 to 1553 A.D.				History from 1553 to 1572 A.D.			
THURSDAY	1	Simple Practice	Introductory Algebra to end of Addition. Garment with the required stitches	Map of England		Addition and Subtraction of Algebra. Garment with required stitches	Euclid Definitions, Book I. Garment with req. stitches	French or Latin		Political Map of England	Composition or Paraphrasing	Literature, Repetition, and Writing		Geography of England	Literature of Anglo-Saxon Period	Subtraction of Vul. Fractions. Bills of Parcels	
	2	Mixtures. The different kinds of Vulgar Fractions		Map of France			Post. and Axioms, Book I. Garment with req. stitches			Map of France				Geography of Spain and Portugal	Literature of Norman Period	Compound Proportion. Complex Fractions	
	3	Square Root. Multiplication of Decimals		Map of India			28 Props., Book I. Garment with required stitches			Map of India				Geography of Arabia and Persia	Literature of Tudor Period	Present Worth. Reduc. of Vul. to Dec. Fractions	
FRIDAY	1	Measures and Multiples. Practice	Drawing	Notes and Scales or the Modulator		Common Denom., Bills of Parcels, and Lowest Terms	Drawing	Instrumental or Vocal Music		Addition of Vulgar Fractions. Practice	Drawing	As in First Week		Dates and main facts from 121 to 410 A.D.	Drawing	Instrumental or Vocal Music	
	2	Simple Proportion. Division of Fract.		Major Scales or Key Removes and Bridge Notes		Simple Proportion. Multiplication of Vulgar Fractions				Comp. Proportion. Division of Vulgar Fractions				Dates and main facts from 1106 to 1189 A.D.			
	3	Mensuration of Squares. Division of Decimals		Minor Scales		Mensuration of Rects. Mult. and Div. of Decimals				Equa. of Payments. Reduc. of Vulgar Fract. & Decimals				Dates and main facts from 1535 to 1572 A.D.			
SATURDAY	1	French or Latin	Science	Examination	French or Latin	Science	Examination		French or Latin	Science	Examination		French or Latin	Science	Examination		
	2																
	3																

14. Write out the sharps and flats of the following signatures in the customary order, and state for what *minor* keys they stand :—



Name the following intervals :—

(*a*) **d** to **se** (*b*) **se** to **d'** (*c*) **f** to **se** (*d*) **se$_1$** to **f**

15. Give the principal parts of the verbs *vendo*, *colligo*, *perficio*, and *curro* ; *or*,

Cut out in paper and tack together one leg of a child's pair of drawers.

16. What are the principal irregularities of *aller*, *boire*, *croire*, and *dormir* ?

17. (*a*) If a side of a triangle be produced, the exterior angle is equal to the two interior and opposite angles ; and the three interior angles of every triangle are together equal to two right angles.

(*b*) State and prove the first corollary.

18. (*a*) In what time can a man walk *b* miles if he walks 10 miles in *c* hours? Ans. $\frac{bc}{10}$ hrs.

(*b*) How many yards of carpet 2 feet wide will be wanted for a floor *c* feet long and *d* yards wide ? Ans. $\frac{cd}{2}$ yds.

19. The sides of a triangular field are 181, 259, 300 feet. If its rent be 10s. 9½d., what is the rent per acre?

Ans. £1 0s. 2d. ; *or*,

What are the chief food needs of the body? Mention some typical foods.

N. B.—*For Correspondence, see end of Certificate Article.*

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BY R. C. B. KERIN, B.A. (LOND.),

First in First-Class Classical Honours at Final ; Principal, Carlyon College, Chancery Lane, W.C.,

AND E. J. SCHWARTZ, B.A. (CAMB.),

Mathematical Scholar and Honoursman in Tripos.

[Owing to pressure of space we have to hold over Vergil Notes, French, English, Greek and Algebra Notes till next month.]

LATIN.

Errata in Last Month's Course.

For Latin Course 'Allen §§ 108–211' should have been '§§ 108–111.' In Exercise 1, for *mortem* read *supplicium*. In Exercise 7, for 'in a principal tense' read 'in a primary tense.'

Latin Course for May.

1. Vergil Aeneid III. 440–592.

2. Grammar : (*a*) Postgate's Latin Primer (Cassell), §§ 54–80 ; §§ 142–156 ; §§ 313–332 ; or (*β*) Allen's Latin Grammar (Clarendon Press), §§ 38–58 ; §§ 103–107 ; §§ 120–133 ; §§ 238, 239 ; §§ 255–272.

3. Translation at Sight : A couple of pieces a week.

4. Bayfield : Exercises 5–24, 10–12 in each ; Exercises 24–80, the seventh one in each.

Latin Grammar Notes.

Although we have now reached the verbs, still the declensions must be constantly looked up, and the rules for gender frequently referred to. In this month's course we shall call the attention of our students to the following points : The four regular conjugations of verbs should be carefully gone through, and the resemblances which they bear to each other should be noted. The resemblances are well brought out in the comparative table of endings in the grammar. Note that deponent verbs are verbs that are passive in form, and active in meaning, and are so called because they lay down (*depono*) the passive meaning. They are the only verbs that have a perfect active participle—some deponent verbs have a perfect participle with a passive signification. Note the verbs in *-io* of the third conjugation that drop the *i* before *i*, *e* final, or short *er*, like *capio*, *facio*, etc.

The translation of the present subjunctive by 'may' is only correct (1) in wishes, as 'may he do this,' *hoc faciat;* (2) in a final clause, as *hoc facio ut valeat*, 'in order that he may be well.' Otherwise 'may' is translated by *licet* when equivalent to 'it is permitted,' or by *potest fieri ut* when equivalent to 'it can be that' ; *e.g.*, *ei hoc facere licet*, 'he may do this,' *potest fieri ut valeat*, 'he may be well.'

The pluperfect subjunctive is translated by 'should have' when it occurs in a principal sentence, otherwise the pluperfect indicative in English generally translates it.

The two English translations of the Latin perfect should be noted. The context decides which is to be used. It should be remembered that the perfect with 'have' is regarded as a primary tense, the perfect without 'have' as a secondary tense.

In the syntax, note the remains of locative case in names of towns and small islands, *domus* and *rus*. Note the mode of expression when the word *urbs* or *oppidum* is used, as *in urbe Roma*, 'in the city of Rome.' Note that 'motion from' is normally expressed by the abl. with a preposition, except in the names of towns or small islands. *By*, after a passive verb, if used (1) with the agent, is translated by *a* or *ab* with the abl. ; (2) with the instrument, is not translated, and the abl. alone is employed. With regard to method of expressing price, the genitive is used for indefinite, the ablative for definite (and sometimes indefinite) price, as *hoc pluris vendidit*, *hoc tribus sestertiis vendidit*. Learn the distinction between the ablative and genitive of quality, noting that the nouns in the abl. or gen. must have an adjective ; *e.g.*, 'a man of bravery' is not *vir fortitudine*, but *vir fortis*. Note the ablative of manner, ablative of amount of difference, the ablative of comparison, ablative of respect.

The ablative of attendant circumstances or ablative absolute is very important. The examples of it given in the grammars are well worth studying. The following are limits to its use ; (1) The subject of it must be independent of the rest of the sentence ; *e.g.*, *eo absente Caesarem laudavit*, 'he praised Cæsar in his (C.'s) absence,' is not to be imitated where *eo* refers to *Caesarem*. The sentence should run, *Caesarem absentem laudavit*. (2) The ablative absolute should be a short clause.

Poetical and Greek usages of the genitive and ablative are important. Note the following : (1) gen. of respect, *integer vitae*, 'upright in life' ; (2) gen. of separation, *desine querelarum*, 'cease from complaints' ; (3) gen. of cause, *notus in fratres paterni animi*, 'known on account of his fatherly feelings towards his brothers' ; (4) abl. of place without a preposition ; (5) abl. of the instrument with the prep. *a* or *ab*, Vergil A. III., *a fluctu curvatus*. Note in *Postgate* the different methods of translating the preposition *with* into Latin (§ 331). The constructions of *dignus*, *indignus*, *contentus*, and *fretus* are important. Students should avoid using *dignus* and *indignus* with genitive, as that construction is not found in Cicero. Distinguish the subjective and objective genitive ; *e.g.*, *amor patris*, 'the love felt by a father' (the father is the subject of the love), subjective genitive ; *amor patris*, 'the love felt for a father' (the father is the object of the love), objective genitive. The predicative genitive is the genitive used as a predicate with the verb *est*, as *sapientis est hoc facere*, 'it is the mark (sign, characteristic) of a wise man to do this.' Note the constructions of *interest*, *refert*, *circumdo*, *induo*, *fruor*, *fungor*, *vescor*, *nitor*, *opus est*, *interdico*.

The classes of verbs that are followed by the genitive or ablative are important. Among the principal genitives expressing offences, accompanying verbs and adjectives of accusing, note the following : *repetundarum* (extortion), *veneni* (poisoning), *maiestatis* (high treason, the full phrase is *laesae maiestatis*), *ambitus* (bribery), *furti* (theft), *caedis* (murder). Note, 'to accuse of violence, assassination,' *de vi*, *inter sicarios accusare*.

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Note the partitive genitive, remembering that 'all of us' is not expressed in Latin by *omnes nostrum*, but by *nos omnes;* as 'of us' is not a real partitive genitive, as 'all' is coextensive with 'us,' and not a part of it. Note *ad Vestae ventum est* where *templum* is omitted.

Note that the abl. expresses (1) point of time, (2) time within which an event happens. Also note the different ways of translating 'three days after.'

Latin Sentences.

(1) I am inclined to think he went to the Senate at Rome without speaking to the soldiers of these matters.

Haud scio an Romam ad senatum iverit nec militibus de his rebus sit locutus.

Notes.—(*a*) The student should avoid using *haud* with verbs except in this phrase, as it is generally used with adjs. or adverbs; though it is found in Cicero with all parts of *scio*. Note that *haud scio an* is an elliptical phrase, as there is an ellipse of a *utrum* clause after *scio* introduced by *an*. The subjunctive *iverit* is due to the dependent question, and the tense is in accordance with the rules of the sequence of tenses, see (7) (*c*) last month; the perf. is used because the time of "going" is antecedent to that of '*scio*.' (*b*) Note that *ad senatum Romae* would be wrong; see (3) (*a*) last month. (*c*) Note that *without* followed by a verbal noun in English is never translated by *sine* and the gerund in Latin (*sine* is only used for *without* before a noun that is not verbal), but by *nec* and a finite verb after a positive clause. After a negative clause *without* is translated by *quin* and subjunctive, *e.g.*, 'He never came to Rome without asking me this': *Nunquam Romam venit quin hoc me rogaret.* In the above the subjunctive is used because *locutus sit* is a co-ordinate verb to *iverit*. (*d*) 'Of' after verbs, when it means 'concerning,' is generally translated by *de* and the ablative. The genitive would be inadmissible here. (*e*) The preposition 'to' and a noun after verbs of *speaking, giving,* &c., are translated by the dative of the Latin noun.

(2) I have no doubt that he is too wise to set out from Rome in three days.

Non dubito quin sit sapientior quam qui Roma tribus diebus proficiscatur.

Notes.—(*a*) *Negative* verbs of doubting, or virtually negative verbs of doubting, *e.g.*, *vix dubito*, 'I scarcely doubt,' are followed by *quin* and subjunctive in Latin when followed by a 'that' clause in English. For the tense of the subjunctive *sit* see (7) (*c*) last month. (*b*) '*Too*' and an adjective followed by a 'to and infinitive' clause in English are translated in Latin by the comparative of the adj. followed by *quam qui* and the subjunctive. The literal translation is 'wiser than he who would set out.' (*c*) *Tribus diebus*—abl. of time within which an event happens. This could also be expressed by *intra tres dies.* For *Romam* without a preposition see (2) (*g*) March number. For tense of subjunctive see (7) (*c*) April number.

(4) Twenty years ago the gallant Strabo advanced by forced marches to the winter camp at Capua.

Abhinc annos viginti Strabo, vir fortissimus, Capuam ad hiberna castra magnis itineribus contendit.

Notes.—(*a*) 'Ago' is translated by *abhinc* with the accusative. It is better to avoid the use of the ablative with *abhinc*, as the instances of it in Cicero are not authentic. (*b*) An adjective used with a proper name in English is separated from it by *vir* in Latin. (*c*) For the two accusatives *Capuam ad hiberna* see (3) (*a*) April number.

(5) All the best men will try to persuade him to consult the interests of the general when absent.

Optimus quisque ei persuadere conabitur ut imperatori absenti consulat.

Notes.—(*a*) 'All the' followed by a superlative adjective is translated into Latin by the superlative of the adjective followed by *quisque*. This phrase will of course require a singular verb. (*b*) Verbs of *persuading* are followed by the *dative.* (*c*) Most verbs of endeavouring, showing, advising, &c., are followed by *ut* and subjunctive when followed by 'to and the infinitive' in English. *Conor*, however, is an exception, and takes the infinitive. *Persuadeo* is not an exception. Hence *ut* and *consulat.* (*d*) *Conabitur* is a primary tense, and the action of consulting is future to that of persuading, hence the present subjunctive. See (7) (*c*) April number. *Consulo* with *dative* means to 'consult the interests of.' (*e*) 'When absent' must not be translated by *cum absenti. Cum* cannot be used except with a finite verb, and in cases like this the idiomatic way is to omit 'when,' and make the adjective or participle or noun agree with the word to which it refers; *e.g.*, 'he did this when consul': *consul hoc fecit,* not *cum consul.*

(6) We were persuaded that Balbus had hoped to stop at Syracuse for three days.

Nobis persuasum est Balbum speravisse se Syracusis tres dies esse moraturum.

Notes.—(*a*) *Persuasi sumus* would be bad Latin. *Persuadeo* governs dat. of the person, and is therefore intransitive. Hence in the passive it can only be used impersonally. The literal translation would be, 'it was persuaded to us.' See (9) (*d*) last month. (*b*) Verbs of *persuading* and *advising,* when followed by a 'that' clause in English, require in Latin the acc. and infinitive. (*c*) For the future infinitive after the verb of *hoping,* where in English 'to' and present infinitive are employed, see (1) (*b*) March. For use of *se* and not *eum* see the same. (*d*) Syracuse is in Latin *Syracusae,* a plural noun; hence the use of the ablative to denote *place where.* See (4) (*b*) April. (*e*) *Time* 'how long' is expressed by the accusative, hence *tres dies.*

(7) I fear that all of us are not worthy to receive a great reward.

Metuo ut omnes digni simus qui magnum praemium accipiamus.

Notes.—(*a*) After verbs of fearing a positive clause introduced by *that* or *lest* is translated by *ne* with the subjunctive; a *negative* clause, as here, by *ut* or *ne non* (*ut* originally meant *how* in such cases). The infinitive follows verbs of fearing in Latin when it does in English, as *mori timeo,* 'I fear to die.' (*b*) The present subjunctive *simus* is due to *metuo* being a primary tense, see (7) (*c*) April. (*c*) For 'all of us' expressed by *omnes* with a verb in the first person plural, see grammar notes this month. (*d*) *Dignus* and *indignus* when followed by 'to and infinitive' in English are followed in Latin by *qui* and *subjunctive;* lit. 'who would receive,' 'such as would receive,' *consecutive* subjunctive.

Latin Test Paper.

(*For regulations, see Correspondence at end.*)

(1) Comment on any peculiarities in the declension of *rastrum, nequam, ales, fas, plures, celer, vates, Neapolis,* and *nemo.*

(2) Give the comparative and superlative of *pulcher, sacer, dives, beneficus, anticus, providus, similis, idoneus, iuvenis.*

(3) Is *unus* ever used in the plural?

(4) When are distributives used in Latin? Illustrate your answer.

(5) What verbs in Latin are followed by two accusatives? And what becomes of the two accusatives when the verbs are used in the passive?

(6) Explain the terms: *Cognate Accusative, Greek Accusative, Accusative of Space, Predicative Dative, Ethical Dative.*

(7) Show by examples how to express in Latin the preposition 'to' followed by a noun.

(8) Correct or justify:—

(*a*) *Hoc fecisse debuit.* (He ought to have done this.)

(*b*) *Artus tremit.* (He trembles in his limbs.)

(*c*) *Hoc me petivit.* (He asked me for this.)

(*d*) *Bonum esse videtur.* (He seems to be good.)

(*e*) *Milites Caesare parcuntur.* (The soldiers are spared by Caesar.)

(*f*) *Cum gladio interfectus est.* (He was killed with a sword.)

(9) Translate into Latin:—

(*a*) Let us pity the innocent, and help the needy with all our power.

(*b*) We were unworthy to be honoured by such a man as this.

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(*c*) Ten years after we were induced to leave the city of Rome.

(*d*) Each of us hopes to reach old age.

French Course for May.

(1) Five pages of translation a week, with a certain amount of written translation.

(2) Grammar: Fasnacht, § 33–38, with a revision of the work set previously.

Greek Course for May.

An elementary edition of Book 24 has just been published in MacMillan's series, with a grammatical introduction, notes, and a vocabulary which students will find extremely useful.

(1) Iliad 246–338.

(2) Grammar: Passive and Middle Voice of λύω, with revision of grammar given in the preceding months.

Carefully revise the declensions in addition to λύω, and do some exercises in 'Underhill.'

3. Two pieces of translation at sight a week.

English Course for May.

1. Hewitt & Beach, pp. 108–176, or Morris's Outlines, Ch. XIII., down to § 294, with Beach's Elements, pp. 53–60; pp. 64–78.

2. History from Richard I. to end of reign of Henry III.

MATHEMATICS.

Algebra Course for May.

The student may this month read the chapters dealing with the solution of easy quadratic equations. A formula is given in many text-books, by the aid of which the roots or answers to a quadratic equation may be at once written down. This formula should never be used when a quadratic equation is set for solution; it is not only the correct answer, but also the method of obtaining it which is required.

Euclid Course for May.

Read the first ten propositions of Book III.; in some editions two different proofs are given of the same proposition; it is, of course, only necessary to select one of them.

Riders:

(1.) Show how to describe a circle passsing through 2 given points, and having its centre on a given straight line.

(2.) Given an arc of a circle, show how to complete the circle of which it is a part.

(3.) Prove II. 13 by the figure of I. 47 without using propositions beyond Book I.

(4.)

Hints on the April riders:

(1.) Is proved by drawing AD from vertex perpendicular to base BC. II. 12 and 13 give expressions for squares on AB and AC, which, when added, give the required result. This is an important and well-known rider, and may be used in solving other riders; it thus forms a good introduction to (2), which is easily solved by its aid.

(3.) By II. 1, rect. BA AC = sum of rect. BD AC, rect. CD AC, and square on AC
= rect. BD CD, and twice square on CD, since CA = CD,
= rect. BC CD and square on CD, by II. 3.

Again, rect. BA AC = square on BC = sum of rects. BC CD and BC BD.

Hence rect. BC BD = square on CD.

(4.) This was misprinted, 'so that rect. BA AC = square on BC;' as it stood it was capable of many different solutions. It may be solved by a method similar to II. 11, the construction being as follows: On AB describe square ABHK, bisect BH in E, and produce BH to M, so that EM = EA; on BM, the side remote from AM, describe square BMPC. Then C is required point.

(5.) The following is the construction for bisecting a quadrilateral ABCD by a straight line through A. To AB apply a parallelogram ABEF equal to the quadrilateral, and having at B an angle equal to angle ABC, so that BE and BC are in same line. Join AE, cutting CD in H. Through E draw EK parallel to CA, cutting CD in K, and join AK. Then triangle AEB, being half of parallelogram ABEF, is half the quadrilateral. Again, since EK is parallel to CA, the triangle EKA equals triangle EKC, and hence the triangles KHA, KCE, are equal; therefore the figure ABCK is equal to the triangle ABE, or half the quadrilateral.

MECHANICS.

Course for May.

Learn by heart the three laws of motion as given by Newton, and get up carefully some facts from nature in illustration of the principles stated in them. Be able to deduce the equation $P = mf$ directly from Law II., and note that this important equation is only true for certain units, viz.:

(1.) P the force in dynes (a dyne = $\frac{1}{981}$ of a gramme),
m the mass in grammes,
f the acceleration in centimetres and seconds;

or

(2.) P in poundals (a poundal = $\frac{1}{32}$ lb. = $\frac{1}{2}$ oz.),
m in lbs.,
f, feet and seconds.

Do not confuse the terms mass and weight; mass is simply quantity of matter, and weight is the attracting force of the earth on any mass. Thus a piece of lead removed entirely away from the earth and other attracting bodies would still possess mass, but not weight, which latter implies the existence of an attracting body. Note that an ordinary balance measures really masses, and a spring balance weights.

The unit of mass, 1 lb., is the quantity of matter in a certain standard,—a piece of platinum at the Exchequer; the weight of 1 lb. is the attraction of the earth for this or any equal quantity of matter.

The unit of force, or poundal, is that force which, acting on a mass of 1 lb., gives it a unit acceleration, *i.e.* increases its velocity every second by a velocity of 1 lb. per second.

Note that at different parts of the earth g has different values, so that for any given quantity of material different readings will be obtained by a spring balance at different places, *e.g.* London and Rome.

Many examples should be worked out in this important branch of the subject, and a good set of average difficulty are to be found in Loney's Mechanics.

As an illustrative example:

What force will stop a mass of 3 lbs. moving at the rate of 20 ft. a sec. in (1) 2 secs.; (2) 2 ft.

(1.) Here $v = 0$, $u = 20$, $t = 2$, and f, the retardation, is found by formula $v = u -$ ft. to be 10 ft. per sec.

Hence by formula, $P = mf$, the force.

$P = 3 \times 10$, or 30 poundals = 15 oz.

(2.) Here $v = 0$, $u = 20$, $s = 2$, and f, the retardation, is found by formula $v^2 = u^2 - 2fs$ to be 100.

$$\therefore P = mf = 3 \times 100 = 300 \text{ poundals}$$
$$= \tfrac{300}{32} \text{ lbs.}$$
$$= 9\tfrac{3}{8} \text{ lbs.}$$

Correspondence.

Teachers wishing to have their test papers corrected should send the same addressed to the 'Matriculation Editors,' care of Joseph Hughes and Co., Froebel House, St. Andrew's Hill, Doctors' Commons, London, E.C., and enclose a remittance of 6d. for each paper.

Next month there will be test papers in Latin, French, Mechanics and Mathematics.

The Matriculation Editors will be pleased to reply briefly through these columns to those seeking advice.

Owing to exceptional pressure on our space this month, we have been obliged to hold over several important contributions, all of which will appear in our next issue. Under the heading of 'Our Publishers and their Representatives,' a fully illustrated sketch of Messrs. George Gill and Sons will also appear.

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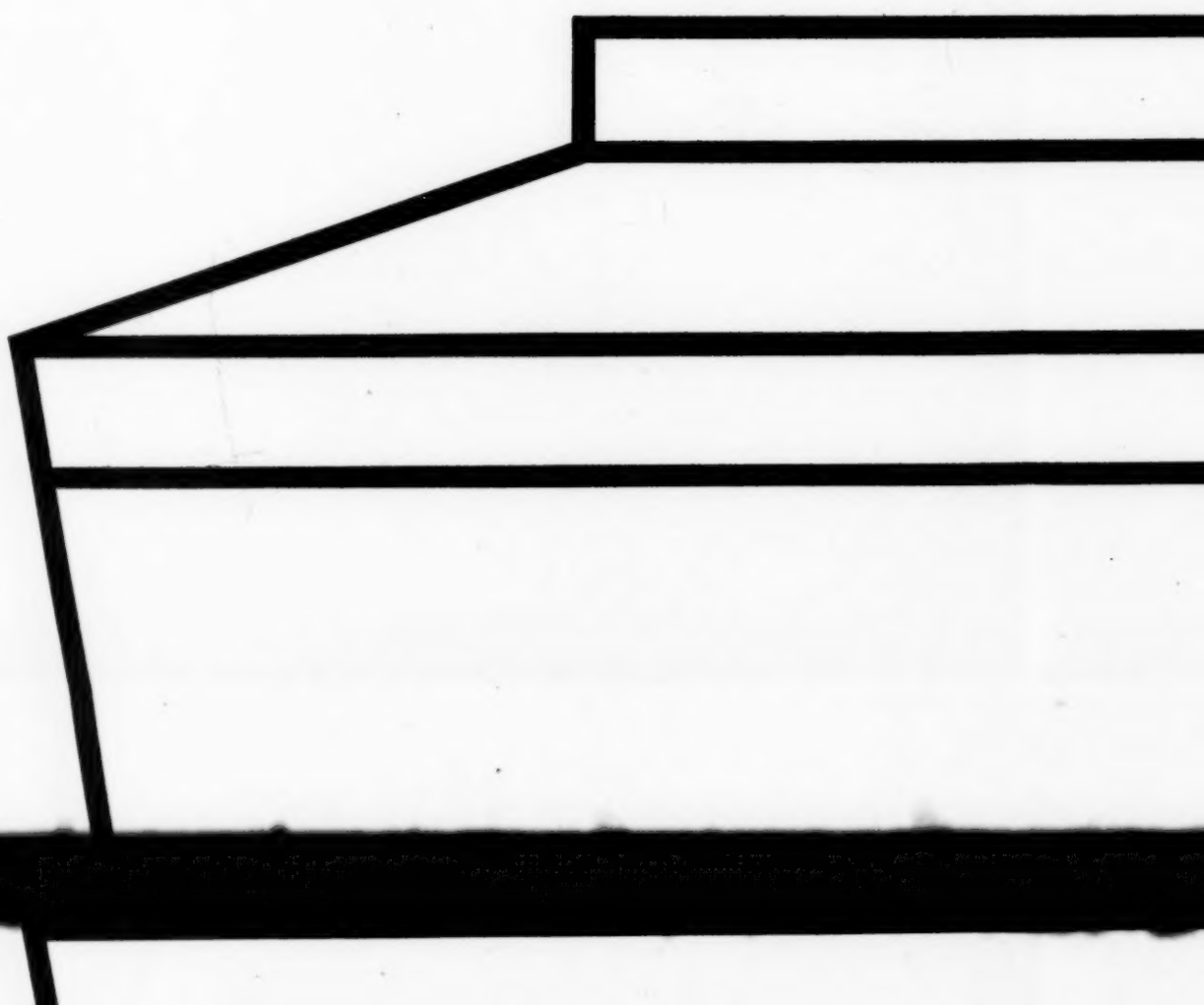

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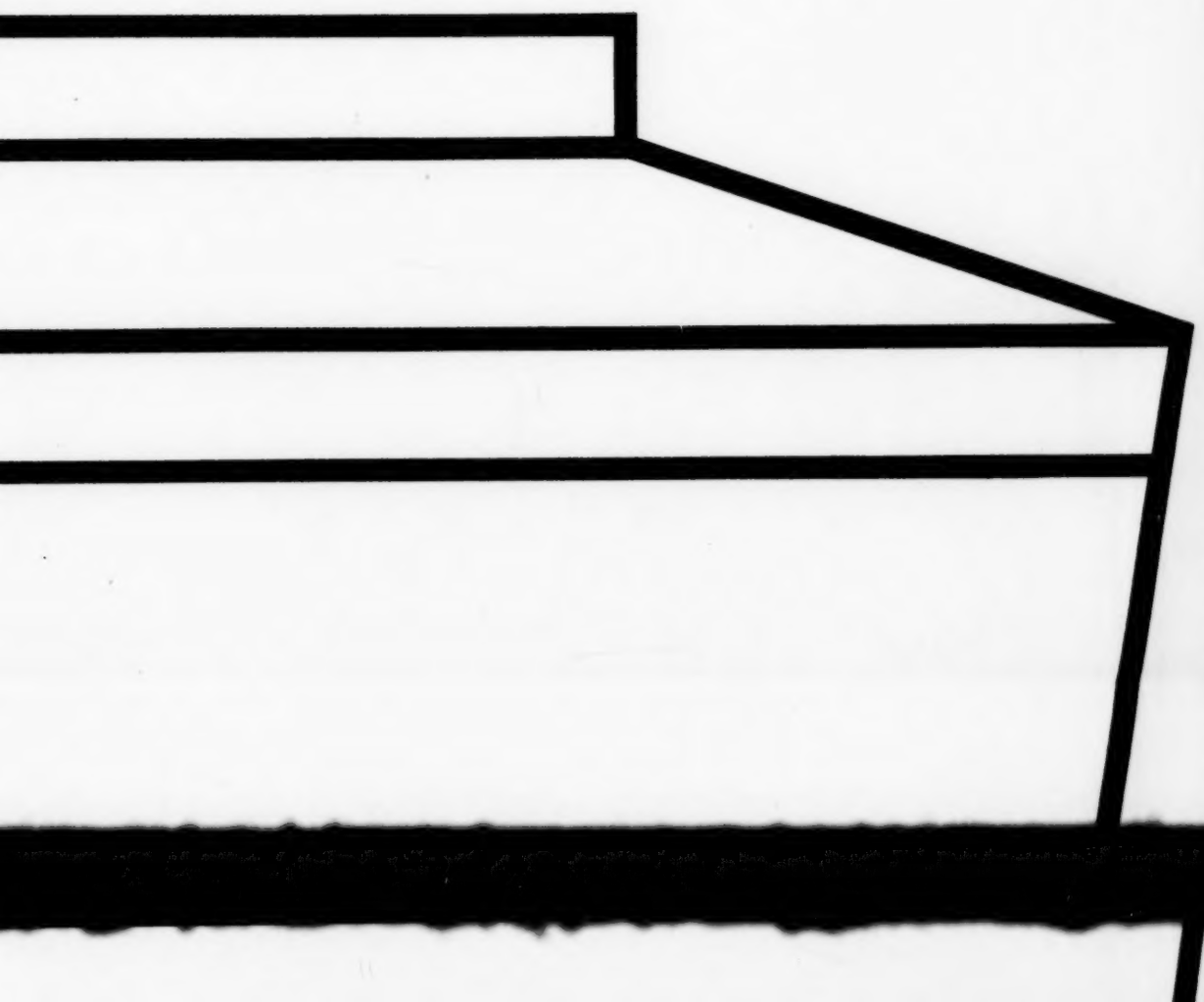

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COUPON
PRACTICAL TEACHER
MAY, 1894.

PRINTED BY EYRE & SPOTTISWOODE, *Her Majesty's Printers*, DOWNS PARK ROAD, N.E., and PUBLISHED BY THE PROPRIETORS, JOSEPH HUGHES & CO., AT FROEBEL HOUSE, ST. ANDREW'S HILL, DOCTORS' COMMONS, LONDON, E.C.